IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF MONTANA

GREAT FALLS DIVISION

Case Nos. CV 17-29-GF-BMM, CV 17-31-GF-BMM

INDIGENOUS ENVIRONMENTAL NETWORK and NORTH COAST RIVER ALLIANCE, and NORTHERN PLAINS RESOURCE COUNCIL, et al., v. UNITED STATES DEPARTMENT OF STATE, et al., and TRANSCANADA KEYSTONE PIPELINE, and TRANSCANADA CORPORATION

EXPERT REPORT OF DR. KARINE GIL, DR. HENRY WEIR, and DR. FELIPE CHAVEZ-RAMIREZ

PREPARED ON BEHALF OF NORTHERN PLAINS RESOURCE COUNCIL, BOLD ALLIANCE, NATURAL RESOURCES DEFENSE COUNCIL, SIERRA CLUB, FRIENDS OF THE EARTH, AND THE CENTER FOR BIOLOGICAL DIVERSITY

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SUMMARY OF CREDENTIALS

KARINE GIL, Ph.D.

Dr. Gil is a Biologist, with a Master's degree in Applied Ecology, and a Ph.D. in Wildlife and Fisheries Sciences from Texas A&M University. Her research experience concerns bird reproductive biology, demography, distribution, diet, and modeling population dynamics of migratory birds. Dr. Gil has been a Whooping Crane and Sandhill Crane researcher since 2002. She developed her Ph.D. dissertation on the wild Whooping Crane population demography and environmental factors affecting their life cycle during the last decades. Her Whooping Crane banded data analyses have allowed scientists to develop new demographic models of the species. Dr. Gil was a Crane ecologist at the Whooping Crane Trust (2006-2011), where she acted as the Whooper Watch coordinator, and developed demographic and energetic models of Whooping Cranes, worked on migratory ecology, and the Whooping Crane Tracking Partnership telemetry project. Her field activities included monitoring and data collection on Whooping Crane and Sandhill Crane migration, confirming sighting records of Whooping Cranes and training Whooper Watch volunteers. Dr. Gil has organized several workshops on Whooping Cranes, including three Whooping Crane Conservation Action Planning meetings for crane scientists from Canada to Texas. Currently, Dr. Gil is the Research Director at Ecosystems Advisors L.P., where she has worked to develop and analyze the first integrated historical database of Whooping Cranes for Nebraska, requested by the Platte River Recovery and Implementation Program. Dr. Gil continues analyzing demographic data from banded and un-banded Whooping Cranes, and participates in the current Population Viability Analysis (PVA) of the Aransas-Wood Buffalo Whooping Crane population. Dr. Gil's full curriculum vitae is attached hereto in Appendix A.

ENRIQUE WEIR, Ph.D.

Dr. Weir is an Ecologist with a Ph.D. in Ecosystems and Population Ecology. He completed his Post-Doctoral research in Ecology and Systems Analysis and Simulations at Texas A&M University. Research experience includes bird community ecology, Whooping Crane and Cormorant demography, systems analysis and simulations of wetlands ecosystems, research on crane populations and migratory waterbirds, and risk analysis and economic valuations of wetlands ecosystems and bird populations in America. From 2007 to 2011, Dr. Weir was the Systems Ecologist at the Whooping Crane Trust, and conducted research in ecological modeling as it pertains to freshwater and wetlands ecosystems associated with Whooping Cranes and Sandhill Cranes at the Platte River basin in Nebraska. Dr. Weir evaluated the changes of water resources and wet meadows vegetation and theirs effects on the endangered Whooping Crane, Sandhill Cranes and other migratory birds, for which he developed a conceptual model of the ecosystem of the Central Platte River basin. Dr. Weir also participated in monitoring and data collection on crane migrations, and helped in the coordination of Whooping Crane Conservation Action Planning workshops. Dr. Weir is currently an ecological consultant at Ecosystem

Advisors L.P., where he developed a database research project of Whooping Cranes for Nebraska as part of the Platte River Recovery and Implementation Program. Dr. Weir previously held a chair as Professor of Ecology at Zulia University in Venezuela, and has worked as a Visiting Professor at Texas A&M University. Dr. Weir's full curriculum vitae is attached hereto in Appendix A.

FELIPE CHAVEZ-RAMIREZ, Ph.D.

Dr. Chavez-Ramirez is an ecologist with a Master's degree and Ph.D. in Wildlife Ecology from the Department of Wildlife and Fisheries Sciences at Texas A&M University, obtained in 1992 and 1996 respectively. His Ph.D. dissertation project was on habitat use, foraging, and energetics (energy use and needs) of wintering Whooping Cranes. Dr. Chavez-Ramirez has been involved with Whooping Crane projects since he started his Ph.D. dissertation work in 1992 and has continued working on Whooping Crane issues through the present day. His research with respect to cranes includes documenting habitat use patterns, food and foraging activity, and studying energetic strategies, particularly in the winter and during migration and reproduction. Dr. Chavez-Ramirez has spent many years in the field, having visited the Aransas National Wildlife Refuge Complex (NWRC) to continue research on Whooping Cranes more than 30 times, observing and documenting crane behavior and responses to variable conditions. Dr. Chavez-Ramirez has been invited to collaborate and participate in several projects by the U.S. and Canadian governments for his expertise on Whooping Cranes, and is a member of the U.S.-Canada Whooping Crane Recovery Team and the International Union for Conservation of Nature's Species Survival Commission's Crane Specialist Group. He is also a board member of the North American Crane Working Group and worked on the Whooping Crane Conservation Action Plan, which is an initiative by the Nature Conservancy and Gulf Coast Bird Observatory in collaboration with USFWS, U.S. Geological Survey ("USGS"), the Canadian Wildlife Service, and multiple state wildlife agencies. Dr. Chavez-Ramirez was involved in developing the Whooping Crane Tracking Partnership and secured the initial funding and permits for the project to get started. He has participated in all trapping and radio-marking of the cranes in the Whooping Crane Tracking Partnership. Dr. Chavez-Ramirez has published many articles on cranes and other birds, such as wading birds, raptors, and hummingbirds. He has published scientific papers regarding the distribution and abundance, habitat use, migration strategies, overwinter survival, foraging and food use, and the effect of habitat management on birds, among other topics. Dr. Chavez-Ramirez's full curriculum vitae is attached hereto in Appendix A.

COMPENSATION AND PREVIOUS TESTIMONY

As compensation for the preparation of this report, we are each being paid at a rate of $150 per hour. For any testimony as an expert witness at deposition or trial, we would each be compensated at a rate of $175 per hour.

Neither Dr. Gil nor Dr. Weir has contributed testimony as an expert witness, at trial or by deposition, in the last four years.

Dr. Chavez-Ramirez previously served as an expert witness in the matter of *The Aransas Project vs Bryan Shaw*, 930 F. Supp. 2d 716 (S.D. Tex., 2013) (case number 2:10-cv-00075) in the United States District Court for the Southern District of Texas, Corpus Christi Division. His testimony was given in 2011.

SCOPE OF RETENTION

We have been retained to undertake an analysis of the Keystone XL pipeline to review and evaluate the potential impacts to Whooping Cranes from construction and operation of the Project, and specifically to assess the risk the Project poses to Whooping Cranes from collisions with the pump station transmission lines.

This report contains our opinions and the reasons underlying them. Our opinions in this expert report are based on our education, professional experience, information and data available in the scientific literature and maintained by government agencies, and information and data about the Project made available to us at the time our opinions were formulated. The data, documents, and other information we considered in forming our opinions are indicated in the references provided, and a complete list is included as Appendix B.

The opinions expressed in this report are our own, and we are each prepared to testify to all the opinions expressed in this report. Our opinions are based on the data and facts available to us at the time of the writing, and should additional relevant or pertinent information become available, we reserve the right to supplement this report.

SUMMARY OF OPINIONS

The State Department has permitted the construction and operation of the proposed Keystone XL pipeline (the Project), an oil transmission pipeline with associated facilities (pump stations, main line valves, power lines, and other equipment) that would move crude oil from Canada to Steele City, Nebraska. The Project would consist of approximately 1,204 miles of new pipeline, built in a 110-foot-wide construction right-of-way. To access the right-of-way, approximately 191 temporary access roads will be built and maintained throughout construction. Some of these access roads will be permanently maintained to access the pipeline for maintenance.

According to the Environmental Impact Statement (EIS) for the Project, there are approximately 1,073 waterbody crossings along the Project's route, including 56 perennial streams, 974 intermittent streams, 28 canals, 4 artificial impoundments, and 11 artificial or natural lakes,

ponds, or reservoirs.[1] Additionally, approximately 20 pump stations, consisting of up to six electric pumps, a 33-foot communication tower, and a small maintenance building, will be built along the Keystone XL corridor in Montana, South Dakota and Nebraska. Each of these pump stations will require power lines to be constructed in order to provide electrical service to the stations. According to the EIS, this will result in the construction of approximately 375 miles of new power lines.

Keystone XL would require the construction of several power lines directly within the central migratory flyway for the Aransas-Wood Buffalo population of Whooping Cranes.[2] The State Department and the U.S. Fish and Wildlife Service (USFWS) determined that the Keystone XL Project is not likely to adversely affect Whooping Cranes. Our analysis, however, found that the Project is more than likely to result in harm to Whooping Cranes from power line collisions and habitat degradation. The historical Whooping Crane sighting data and the more recent telemetry data from the Whooping Crane Tracking Partnership,[3] which are the best available data to assess the risk of harm to Whooping Cranes, indicate that cranes frequently use and rely on stopover habitat areas in close proximity to proposed power lines for Keystone XL. Therefore, the Project poses a significant risk of harm to Whooping Cranes from collisions with power lines. The use of bird flight diverters may reduce the number of collisions, but they will not prevent harm to the endangered population of Whooping Cranes.

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[1] We understand that these numbers may have changed since the EIS was completed, and may further be affected by the recent Nebraska Public Service Commission decision denying the preferred alternative route and approving a different route that was not analyzed previously.

[2] This is the only self-sustaining wild population of Whooping Cranes. These cranes nest in the Wood Buffalo National Park (WBNP) in Canada, and winter along the Gulf Coast at Aransas National Wildlife Refuge (ANWR), in Texas. This population is therefore referred to as Aransas-Wood Buffalo population.

[3] Data on the presence of whooping cranes includes historical sighting data maintained by the U.S. Fish and Wildlife Service, as well as GPS telemetry data collected from radio-tagged cranes through the Whooping Crane Tracking Partnership.

The Whooping Crane Tracking Partnership is a joint effort of the United States Geological Survey, U.S. Fish and Wildlife Service, Canadian Wildlife Service, and the Crane Trust. For this project, experts (often Dr. Chavez-Ramirez) capture Whooping Cranes and attach a transmitter to their leg, which sends GPS-radio signals received by satellite, in a frequency of every six hours.

The objective of the telemetry project is to document crane movement within the Whooping Crane migratory corridor, and to gather data on behavior and potential mortality events. According to the USGS's description of the telemetry project, the "fundamental objectives" of the project include "to provide reliable scientific knowledge for conservation, management, and recovery of whooping cranes," and the "partners agree that this [project] represents the best prospect in the past 30 years to enhance understanding of whooping cranes and assess risks they face during their entire life cycle." USGS (2012).

Power lines are recognized as the greatest source of mortality for fledged Whooping Cranes in the Aransas-Wood Buffalo crane population, and the Project would require the construction of dozens of miles of power lines within the central flyway—the Whooping Crane migratory corridor (Fig. 1).

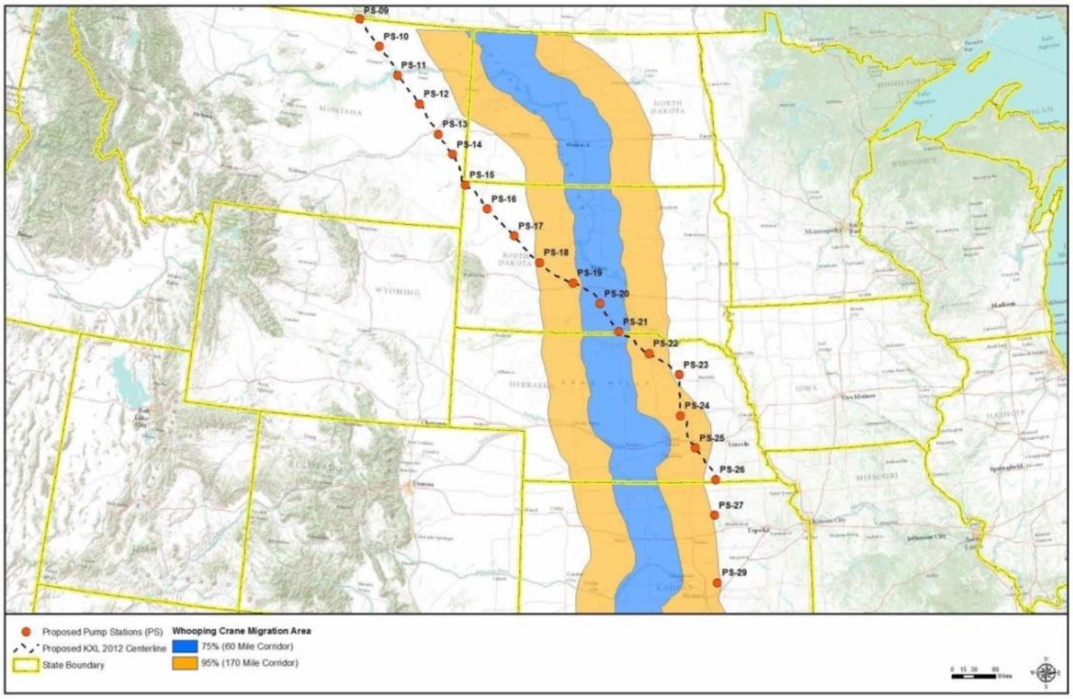

Figure 1. Central Flyway - Whooping Crane Migration Corridor for the Aransas-Wood Buffalo Population. This map depicts the location of the Keystone XL pipeline and pump stations as set forth in the EIS.

We have analyzed the location of the proposed power lines, and we have used historical Whooping Crane sighting reports collected by the USFWS and Whooping Crane radio-telemetry data maintained by the United States Geological Survey (USGS) through the Whooping Crane Tracking Partnership to evaluate the risk of collisions from the Project. We have also considered the proposed avoidance and minimization measures intended to mitigate the impacts to Whooping Cranes, including the use of bird flight diverters. By using historical and telemetry data—which provides specific information on Whooping Crane migratory routes and habitat use—we were able to evaluate the risk from the Project and assess the likelihood of "take" as defined under the Endangered Species Act (ESA).

Based on our analysis, our primary opinions are as follows:

- Whooping Crane collisions with power lines are almost certain to happen over the life of the Project. Power lines are the main known cause of mortality for migrating Whooping Cranes, and the Project would significantly increase the risk of collisions by placing miles of power line directly within the primary migratory corridor and in areas with historic crane use.

- The Whooping Crane historic sighting and telemetry data indicates that many Whooping Cranes rely on habitat areas that would be affected by the Project, and in some cases proposed power lines may separate potential feeding and roosting habitat, which presents the greatest risk of collision when the birds make low altitude flights in low-light conditions.
- The proposed conservation measures are insufficient to prevent Whooping Cranes from colliding with the Project's pump station power lines. The scientific literature on bird flight diverters suggests that these are considered only around 50% effective generally, and therefore may reduce, but will not eliminate the risk of collisions. Moreover, these devices are even less effective for Whooping Cranes, due to the birds' inability to see them, as well as their lack of agility when flying.
- Whooping Cranes will be harmed by construction-related activities including noise disturbance, surveying and monitoring, and changes to the landscape that will prevent cranes from using their known stopover sites, requiring the birds to find new habitat, thereby increasing the risk of collision, predation and stress.

Our analysis of Whooping Crane stopover sites during migration shows 704 data points in close proximity to the Keystone XL pump station power lines, from the combined Whooping Crane telemetry data and USFWS historical confirmed sightings and sub-sightings.[4] The telemetry project data tracked 68 individuals (35 juveniles, and 33 subadults and adults)[5] from 2010 to 2015 (Pearse et al 2015), 31 of which were detected in the Keystone XL project area (46% of all radio-tagged birds). The telemetry records show a total of 667 GPS locations for the 31 tracked individuals in the proximity of Keystone XL. The radio tags provide data points for each tracked individual every six hours, and therefore show the movement of these 31 tracked individuals over the course of their stopovers. This indicates a high amount of localized movement, which as discussed further below increases the risks of collision.

The 704 data points also include 37 different Whooping Crane sightings reported to USFWS in the historical data collected from 1947 to 2017. These data are based on biological reports from confirmed sightings, where biologists from USFWS monitored and recorded daily data from Whooping Cranes during their time at the stopover.

Importantly, the telemetry data comes from the mere 20% of the Whooping Crane population that was radio-tagged, and therefore is representative of a larger population using the Project area, since these birds travel in pairs or larger groups. The flock size of Whooping Cranes during migrations has increased over the years. While traditional family groups averaged 3.57

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[4] Sub-sightings are subsequent observations of the same individual after the initial observation was recorded in a stopover area. The 704 data points do not represent 704 individual birds, but rather include sub-sightings, which show the localized movements (with GPS data collected every 6 hours) of the 31 radio-tracked cranes in the Project area.

[5] Subadults are cranes in all white adult plumage that are not yet known to be mated or breeding.

individuals (1942–2017 data), there are more recent sightings of larger groups (single family with subadults) traveling together, resulting in a flock size from 5 up to 21 individuals in a single stopover location (Gil and Weir 2012). Therefore, each data point may represent several cranes that have historically used the area around the Keystone XL project, and that would be at risk of power line collision.

In sum, it is our opinion that the proximity of the crane population to the Project power lines indicates that there is a high likelihood that Whooping Cranes will collide with power lines for the Keystone XL pump stations. We conclude that this Project presents a substantial risk of harm to Whooping Cranes from power line collisions and habitat disturbance, which poses a significant risk to the species since it remains critically endangered. The loss of a few, and even one, breeding Whooping Crane could jeopardize its recovery and continued existence.

BASIS FOR OPINIONS

A. Whooping Cranes

The Whooping Crane (*Grus americana*) is a critically endangered bird that was listed as endangered under the ESA on March 11, 1967. Whooping Cranes are migratory birds that occur only in North America. They spend summers in central Canada at Wood Buffalo National Park (WBNP) and winter at Aransas National Wildlife Refuge (ANWR) on the Texas coast.

Following decades of recovery efforts, the population of Whooping Cranes is estimated at just over 308 individuals in the Aransas-Wood Buffalo population. Studies have found that in order to be genetically viable, the population needs to reach at least 1,000 individuals (Stehn 2008). This is the only wild self-sustainable population of Whooping Cranes.

Figure 2 . Family of Whooping Cranes at stopover in Nebraska. Spring Migration 2008. Photo courtesy of M. J. Harlow, Photographer and Whooper Watch volunteer.

During their migration, Whooping Cranes use a variety of habitats closely associated with river bottoms, prairie grasslands, seasonally or semi-flooded palustrine wetlands, shallow portions of reservoirs for roosting, and undisturbed, submerged sandbars commonly found in river channels. These habitats are critical for Whooping Crane feeding patterns while migrating; these birds primarily feed on frogs, fish, insects, and various types of plants often found in submerged areas. They travel during the day, in pairs or small flocks, and stop daily to feed and rest.

Whooping Cranes typically leave their wintering grounds in Texas sometime between late March and early May and begin to migrate south from Canada sometime between late October and mid-November. The primary migration corridor, encompassing 95% of known records of Whooping Cranes, is about 2,400 miles long and 220 miles wide.

Whooping Cranes use selective stopover sites during migration, with characteristics that minimize mortality that could result from predation. Whooping Cranes on migration roost in wetlands that have little or no vegetation along the edges and surrounding landscape that could hide predators and use wetlands of a size where approaching predators can be detected. They also use shallow wetlands as stopovers with good visibility around them, meaning they have low vegetation for between 1 and 2 kilometers around the wetlands and averaging 1.3 hectares of open water, as defined by direct observations (Austin and Richert 2005) and telemetry studies (Howe 1989, Rempel and Chavez-Ramirez 2010).

Whooping Cranes have a significant cultural inheritance (young cranes learn life skills and migratory routes from their parents) and this cultural inheritance results in Whooping Cranes following the same migratory corridor as their parents and not expanding into novel areas. During the first migration in the fall, when young of the year travel with their parents, they learn the location of important stopover sites and the characteristics of stopover sites. The current population is expected to continue to follow these inherited migratory routes, as they are all descendants of the 15 remaining Whooping Cranes present in 1941 (CWS and USFWS 2007). This high degree of cultural inheritance means that many future generations of Whooping Cranes will use the same stopover areas, year after year; therefore, any changes to the landscape in known stopover areas and wetlands with appropriate characteristics as stopover sites along the migration corridor could result in potential harm to Whooping Cranes.

Whooping Cranes are especially susceptible to negative impacts from disturbance as they travel across the United States during crucial spring and fall migrations. Suitable stopover habitat is necessary for the Whooping Cranes to rest and eat, and complete their migration in good condition. Reducing mortality and protecting stopover habitat are crucial to the recovery of this species.

B. <u>Whooping Crane Mortality During Migration</u>

The 2010 International Union of Concerned Scientists' Red List includes power line collisions among the main threats that migratory bird species face in their migratory routes (Galbraith

2014). Power lines, including transmission and distribution lines, are known to have negative impacts on bird populations (Shaw et al. 2010, Martin and Shaw 2010, Loss et al. 2014, 2015, Ogada et al. 2015). Based on a long history of direct mortality or crippling due to collisions, power lines represent a major threat to many species, including the endangered Whooping Crane (Malcom 1982). The proliferation of power lines, such as those for the Keystone XL pump stations, poses a substantial threat to birds as they migrate, and if the power lines are developed in critical areas for these species (including near wetlands and forage sites in the central flyway), it significantly increases this threat (Jenkins et al. 2010).

In the United States, rough estimates of annual collision mortality range from hundreds of thousands to hundreds of millions of birds (Manville 2005, Erickson et al. 2014, Loss et al. 2014). Power line collisions can result in the death of significant numbers of migratory birds, particularly many larger migratory birds (*e.g*. swans, geese, cranes, raptors, etc.). This is especially true where the power lines are sited across flight lines or close to habitat areas where these birds congregate, such as wetlands and rivers (Bevanger 1994, 1998, Haas et al. 2003).

Whooping Cranes are particularly prone to mortality by collision with power lines due to several factors, including a large body size that makes collisions more likely for this species than for smaller birds (Bevanger 1998, Shaw et al. 2010). Opportunities for Whooping Cranes to collide with power lines are multiplied when these power lines are suspended across or located near river channels, wetlands, or other low-lying wet areas that serve as Whooping Cranes' primary foraging or roosting habitats (Stehn 2008). Former International Whooping Crane Coordinator and USFWS Biologist Thomas Stehn (2008) further provides that "Power lines dividing wetlands used for roosting from grain fields used for feeding caused the most collisions for cranes because these circumstances encouraged crossing the lines at low altitude several times each day." This is important because we have personally observed Whooping Cranes at stopover areas taking short flights at low elevations between two and five times during the day, and Whooping Cranes tracked via radio telemetry show most movements between overnight roost and day use locations are generally less than five km apart (Rempel and Chavez-Ramirez 2010). It is these low altitude flights that pose the greatest threat to cranes.

Whooping Crane mortality via power line collision has been observed under even optimal weather conditions (Stehn 2008). However, inclement weather associated with poor visibility (fog, dense cloud cover, precipitation) and reduced flight control (high-velocity winds) is "one of the most frequently described factors affecting collisions and can increase the probability of collisions." (Stehn 2008). In dark or foggy conditions, the power lines (and devices meant to warn birds as to their presence) are less visible, and studies show that the probability of collision is increased in these conditions even when cranes are familiar with the power line locations (Tacha et al. 1979, Murphy 2016).

Even when a Whooping Crane is aware of a power line present in its daily flights to and from roost sites, it may still be unable to avoid it at some point. Dr. Chavez-Ramirez has personally observed several Whooping Cranes collide with a power line in an area where they had been

making daily flights for several weeks and had avoided it successfully in the previous days. This tells us that even when cranes are aware of the power lines in their environment and they have successfully avoided them on several occasions, there will always be an increased probability of collision if the power lines continue to be present in that landscape.

Conditions such as high-velocity winds have even been shown to buffet Whooping Cranes into "fully visible power lines with which they are quite familiar, but which they cannot avoid because they cannot maintain flight control." (Stehn 2008). Larger birds, like cranes are less maneuverable and less likely to be able to avoid power lines when in flight due their size, wing span, and wing loading (Bavenger 1998). Cranes and other large birds are known to suffer collisions with power lines at rates greater than smaller species (Rayner 1988, Bavenger 1998). In comparison with other groups of birds, cranes are considered to be poor fliers and therefore less able to react quickly to obstructions encountered in the air (Rayner 1988). Furthermore, encounters with power lines often occur "near sunrise and sunset when light levels are diminished," and therefore, when lines and line markers are not visible (Stehn 2008). Whooping Cranes have in fact been observed taking off as early as 7:30 a.m. and arriving at stopover habitat as late at 7:00 p.m.—times when light levels would be quite low during spring and fall migrations. (Benning 1981, Stehn 1983, 1984, Kuyt 1983).

According to Thomas Stehn, "Collision with power lines is the greatest source of mortality for fledged Whooping Cranes (*Grus americana*) in the Aransas-Wood Buffalo population (AWBP) that migrate between the Northwest Territories, Canada to the Texas coast." (Stehn 2008). Collisions with power lines have been responsible for the death or serious injury of dozens of Whooping Cranes since reports started being collected in 1956, and the actual number may be much higher given the lack of data on Whooping Crane mortality. In the 1980s, two of nine radio-marked Whooping Cranes from the Aransas-Wood Buffalo population died within the first 18 months of life as a result of power line collisions (Kuyt 1992). Of 27 documented mortalities in the Rocky Mountain Whooping Crane (experimental introduced) population,[6] almost two-thirds were due to collisions with power lines (40%) and wire fences (22%) (Brown et al. 1987). Twenty-one individuals within the experimental Florida populations and three individuals in the experimental Eastern migratory population likewise have died from collisions with power lines (USFWS, unpublished data). In a population of reintroduced Whooping Cranes that migrated between Idaho and New Mexico, 39% of all known Whooping Crane mortalities were due to power line collisions (Brown et al. 1987).

The potential for crane mortality from power line collisions can be assessed by looking at the historical data. Most mortality of Whooping Cranes during a year is believed to occur during the

[6] Reintroduced populations were designated as experimental non-essential to facilitate development of new populations of cranes. As experimental non-essential populations, they do not receive the full protections of the ESA. These populations do not interact with the Aransas-Wood Buffalo population at issue here.

migration period (Lewis 1988, 1992, Stehn and Haralson-Strobel 2014), which has been estimated to account for as much as 83% of annual mortality (CWS and USFWS, 2005). In fact, the USFWS historical data shows that up to 50% of juvenile crane mortality may occur during fall migration.

Between 1977 and 1988, the USFWS and Canadian Wildlife Service (CWS) developed a color banding program to understand the demographic dynamics of the Aransas-Wood Buffalo population of Whooping Cranes. Of the 132 color-banded individual cranes surveyed over the following 27 years, information on mortality was analyzed for 101 cranes (Gil de Weir 2006). Notably, 70% of mortality occurred out of the wintering grounds. Of this, 42% of mortality occurred during spring and fall migration, when power line collisions pose the greatest threat to the species. This underscores the risk that migration poses to this species, which is exacerbated by the increasing number of power lines in their migratory corridor.

Based on the USFWS/CWS color banding data, we are able to calculate the percentage of documented individuals that collided with power lines, which was 23% of the 101 confirmed deaths. We are then able to estimate the number of individuals that died per day from 1977 to 2007. We found that at the breeding grounds, 0.18 individuals died per day; at the wintering grounds 0.20 died per day; and during the 57 days of migration (including fall (35 days) and spring (22 days)), 0.74 died per day. These proportions show that the risk of mortality is at least three times higher during migration.

The historical information on wild Whooping Crane mortality during the last decades has also been analyzed by Lewis et al. (1992), Gil de Weir (2006), and Stehn and Haralson-Strobel (2014). In Stehn and Haralson-Strobel's (2014) research, the number of mortalities that occurred during migration was estimated at 55% of 546 (300 individuals). This estimation was calculated from 49 known mortalities, 28 of which occurred during migration (55%), and 10 of which were the product of power line collisions during migration (20.41% from the total mortality) (Stehn and Haralson-Strobel 2014). Extrapolating the data, Stehn and Haralson-Strobel (2014) therefore estimated that as many as 111 individuals died due to power line collisions between 1950 and 2010.

Based on the available data and studies, historical annual mortality of Whooping Cranes from power lines can be roughly estimated at 1.88/yr. As set forth below, this Project will increase the risk and therefore the number of collisions that can be expected. Notably, a population viability analysis in 2004 (217 individuals) found that an additional 3% mortality (*i.e.*, less than 8 individuals annually) would cause the species to decline and thereby preclude recovery (USFWS 2009).

The Keystone XL Project would require the construction of hundreds of miles of power lines within the central migratory flyway. There are several factors that contribute to the risk of avian collisions and increased mortality of Whooping Cranes from the proposed Project, including the placement of power lines on or near areas that are regularly used for feeding or roosting; line

orientation in proximity to the migratory route and existing power lines; and biological factors such as poor vision directly ahead during flight (Martin and Shaw 2010).

What is critically important for the level of mortality risk is whether the birds are exposed to unpredictable or uncertain conditions. Whooping Cranes spend enough time in their wintering and breeding grounds to permit a period of learning and site recognition, which allows them to identify the availability and distribution of resources in a very effective way. During migration, however, only the cranes' site fidelity—previous use of familiar habitat—reduces the unpredictability and uncertainty of the environment. Yet even this is not enough to prevent mortality during the short migratory period, especially with the proliferation of power lines that render their traditional stopover habitats dangerous and/or unusable.

C. Power Line Collisions Pose A Significant Threat And Could Jeopardize The Existence Of The Only Viable Population Of Whooping Cranes

Following decades of recovery efforts that began with just 15 individuals in 1941, the number of Whooping Cranes is estimated at just over 300 individuals in the Aransas-Wood Buffalo population. Studies have found that in order to be genetically viable, the population must reach at least 1,000 individuals (Stehn 2008). In fact, the Avian Powerline Interaction Committee has stated that a single mortality of a Whooping Crane could have significant biological implications for the population (APLIC 1994). Therefore, the loss of a few, or even one, Whooping Crane from a collision with the Keystone XL pump station power lines would affect the survival and recovery of the species.

The non-selective or random mortality of any individual Whooping Crane due to power line collision has a unique impact on the population depending on the bird's age and genetic heritage. The loss of a reproductive adult will have a multiplied effect on the population, due to the loss of the potential contribution of future offspring. Based on banded information, we tracked the reproductive flow success of specific individuals through four generations and confirmed that 59 descendants came from the same pair over a period of 27 years (Gil-Weir 2014). Therefore, the mortality of a single high output individual means decreased long-term reproductive rate for the entire population, since the loss of this breeding pair would have had a cascading effect on the population.

In addition, the removal of an experienced individual (adult) from the population has a greater impact than the removal of a juvenile or sub-adult. Whooping Cranes teach offspring migratory routes and survival skills, such as finding food or identifying safe roosts and stopovers during migration. Also, some adults have a more successful history of reproduction than others. Removing these individuals from the population could affect the survivorship of the species differentially (Gil et al. 2014). The loss of this genetic heritage could have a profound impact on the species.

This is consistent with the findings of Stehn (2008), which stated that "Collision with power lines is the greatest source of mortality for fledged Whooping Cranes (*Grus americana*) in the Aransas-Wood Buffalo population." Stehn (2008) cautioned that "Such mortality affects the recovery of this endangered species and accentuates the need to minimize such losses (Howe 1989). Power line expansion in North America remains one of the chief threats to the species (USFWS 1994)."

Whooping Cranes also often travel in large family groups, a fact which raises the possibility of a large number of collisions occurring at one time, should such a group come upon one of the Project's power lines during low visibility or windy conditions. This could result in several mortalities, with a cascading adverse effect on the population of Whooping Cranes.

D. <u>Proximity Of Whooping Cranes To Keystone XL Power Lines And Associated Collision Risk</u>

To conduct an analysis of the potential for Whooping Cranes to collide with the power lines for the Keystone XL pump stations, we assessed the proximity of the Project to historical crane stopover habitat, using the best available data on Whooping Crane movement and habitat use. For many years USFWS has recorded all the sightings of banded and un-banded Whooping Cranes that were reported by the public and trained Whooper Watch teams throughout the central flyway during migration.[7] These records are maintained by the Service's field office in Grand Island, Nebraska. We visited this office and integrated in a single Microsoft Access database all of the Whooping Crane sighting data (Gil and Weir 2012) and created a spreadsheet of historical sightings in the Project area. In addition, beginning in 2010 the Whooping Crane Tracking Partnership has collected telemetry data from radio-tagged cranes, and this data allows us to see the most recent use of specific areas by individual cranes.[8]

[7] The USFWS observational database consists of observations of Whooping Cranes in migration collected since the 1950's. Whenever a Whooping Crane(s) was observed on migration, a sightings report consisting of date, time, location, number of Whooping Cranes, habitat type in which cranes were observed, behavior, potential disturbance factors, and name of observers was sent to the USFWS office in Grand Island Nebraska, which organized and collected the data. On many occasions, the reports also included photographs of the Whooping Cranes and the landscape in which they were present. The first sighting of a group of cranes was considered a "sighting," with subsequent observations of the same group in subsequent days in the same area called "sub-sightings." While the observational database has been a volunteer effort, the number of sightings collected over many decades has made it a valuable source of information that has helped to determine the crane's migratory corridor (CWS-USFWS 2007), stopover habitat selection and important stopover sites (Austin and Richert 2005).

[8] The raw telemetry data was provided to us by the Center for Biological Diversity, which obtained the data from USGS (which manages the Whooping Crane Tracking Partnership) through a FOIA request. Importantly, only 20% of the Whooping Crane population was radio-tagged, and therefore each data point may represent several cranes travelling with one radio-

We developed several maps depicting the historical USFWS sighting data as well as the telemetry project data (USGS 2017) that was obtained directly from USGS. We have also included data provided to us by the USFWS in a GIS coverage that was included in the administrative record in this proceeding, and which purportedly depicts telemetry data through the spring of 2017. Using these data and maps, we can estimate bird collision and mortality risk based on the location of the proposed power lines in relation to wetland roosting and foraging habitat used historically by Whooping Cranes during spring and fall migration. We observed that several of the historical USFWS sightings and sub-sightings were at the same locations as recent telemetry data records. In fact, the telemetry data only identified a few locations (9% of the areas used by Whooping Cranes) that were not identified using the historical data (Pearse et al. 2015). This confirms the site fidelity observed during migration, which makes the specific location of power lines even more important, because cranes are more than likely to return to these stopover habitat locations.

Notably, it is our understanding that at the time the State Department and USFWS reviewed this Project, no information on the specific locations of power lines for the Nebraska portion of Keystone XL route was made available to these agencies. It is not clear to us how they determined the potential for adverse impacts without this information. It is further our understanding that the Nebraska Public Service Commission has approved a route through Nebraska that was not previously considered by the State Department or USFWS. Since no details regarding that route are available—such as where the pump stations and power lines would be placed—it is not possible for us to analyze the potential impacts to Whooping Cranes from that new route at the same level of specificity. However, given the proximity of cranes to the new route as shown in the telemetry data, it is evident that there is a high likelihood of harm to Whooping Cranes from construction and operation of Keystone XL, even in this new location, which crosses the Platte River in the vicinity of several Whooping Crane data points.

1. <u>Analysis</u>

Whooping Cranes travel around 400 kilometers (250 miles) between stopovers during the 11-days (on average) migration across the United States to complete the 4,000 kilometer (2,400 mile) trip from Woods Buffalo National Park in Saskatchewan to the Aransas National Wildlife Refuge in Texas (Kuyt 1992). Therefore, the birds are at risk of collisions with power lines at certain key stopover points when they are taking off or landing, which can be ascertained from the historical sighting and telemetry data. The placement of the power lines is crucial: Stehn and Wassenick (2008) provide that "Power lines dividing wetlands used for roosting from grain fields used for feeding caused the most collisions for cranes because these circumstances encouraged crossing the lines at low altitude several times each day."

With this basic understanding of habitats associated with collision risk, we have used the

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tagged individual, since these birds often travel in extended family groups of up to 5-12 birds in a flock (USFWS 2015).

telemetry data to assess whether the Project is being placed in areas that pose a significant risk of collisions.

The following assumptions were used to form the basis of our opinion:

- Whooping Cranes show site fidelity (the tendency of an organism to stay in or habitually return to a particular area), returning to familiar stopover locations during subsequent migrations as observed in banded individuals from the USFWS historical data and Telemetry Project records. Whooping Crane site fidelity is due to the cultural inheritance (learning critical lifecycle information from parents to offspring) present in the species. For Whooping Cranes, the migratory route, as well as other important components of the yearly cycle, appears to be learned rather than innate (Lewis 1995), since juveniles travel with their parents on their first migratory voyage to the wintering grounds (Kuyt, Johns, Stehn pers. comm., pers. observ.).
- Whooping Cranes have shown high levels of visual recognition of landscape features during migration along the central flyway in the search of their stopover sites, and they will circle over stopover habitat in order to memorize the location and to teach other cranes, especially the young of the year, where to land during migration.
- Family groups have shown that they migrate together, with up to four generations together in a flock, and typically stop at the same stopovers during migrations year after year.
- The movement patterns of Whooping Cranes during stopovers are limited to wetland roosting areas and adjacent feeding areas.
- Each data point represented on the maps likely represents more than a single individual crane using the same habitat. Only 20% of the population was tagged, and Whooping Cranes often migrate as pairs, families (parents with the young of the year), or larger families like those that include sub-adults of the same family.
- Whooping Cranes may move in any direction during stopovers in search of food and stay for several days or even weeks until weather conditions are sufficient to continue their migration. Cranes with low or no energy reserves will tend to forage at stopover sites. In addition, pairs with young or the younger sub-adult birds will tend to migrate at slower speeds (meaning they will take more days to complete the migration) and are likely to spend several days in the same stopover area. Previous studies (Kuyt 1983, Stehn 1983, and Stehn 1984) and information available from the Telemetry Project (Rempel and Chavez-Ramirez 2010) clearly show that on many occasions migrating Whooping Cranes will spend more than one night at a stopover site. In fact it could be more than a week in some cases. We documented two Whooping Crane family units during a spring migration, where one of the crane groups spent 11 days in Kansas, while the other group spent 13 days in South Dakota (Rempel and Chavez-Ramirez 2010). When cranes spend time in an area, the crane will tend to move each day (except under bad weather

> conditions), flying away from stopover roosts to other areas presumably in search of food, and then return to the original stopover roost sites or other nearby locations. These flights to foraging areas vary but can be as much as 10 km away from the stopover roost. We documented movement between overnight roost and day use areas to be less than five km in two spring migrating Whooping Crane groups (Rempel and Chavez-Ramirez 2010). The shorter the distance between two areas the closer to the ground the cranes will fly, increasing probability of collisions with power lines.

The following maps provide an overview, depicting the USFWS Whooping Crane historical sighting data and the Whooping Crane Tracking Partnership telemetry data across the Project route (with more specific examples provided in the following section) (Figs. 3, 4, and 5). These maps indicate where pump station power line locations were proposed at the time the State Department and Service undertook their analysis, as shown in maps included in the EIS and Biological Assessment for the Project. While the location of these power lines may have changed since then, we believe it is prudent for this report to show the information that was before USFWS when it made its determination regarding this Project. The maps that follow in Section (D)(2) depict the most current information we have on power line locations (Figs. 6-12).[9] Based on the data set forth in these maps, it is our opinion that the construction and operation of Keystone XL is more than likely to result in harm to Whooping Cranes through power line collisions.

[9] The current locations of the proposed power lines were obtained from maps that were included with the USFWS administrative record in this matter. The maps depicted the location of the proposed lines in 2012 as compared with the location in 2017 for South Dakota and Montana; however, they only provided limited information on the power line locations for Nebraska, with several lines missing. The power lines were digitized from the .pdf maps in the record, and therefore show the most current data available on power line locations.

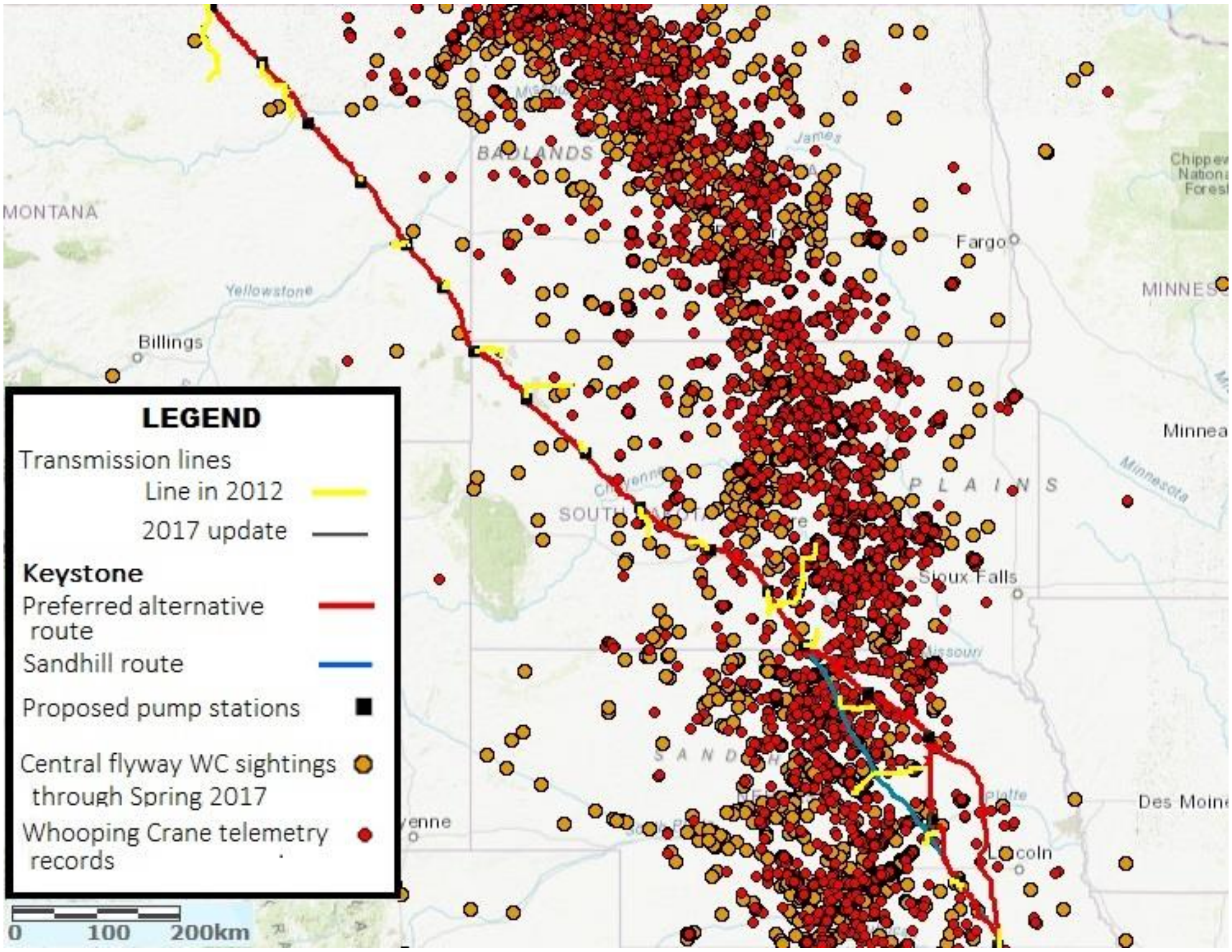

Figure 3: Project Overview - Whooping Crane USFWS historical sightings (orange dots) and telemetry project records (red dots) located in Nebraska, South Dakota and Montana. Note that proposed power lines are shown in yellow for the locations that were known in 2012, and updated locations as of 2017 are shown in gray. Several of these power lines and the pump stations (black squares) are located very close to areas used by Whooping Cranes.

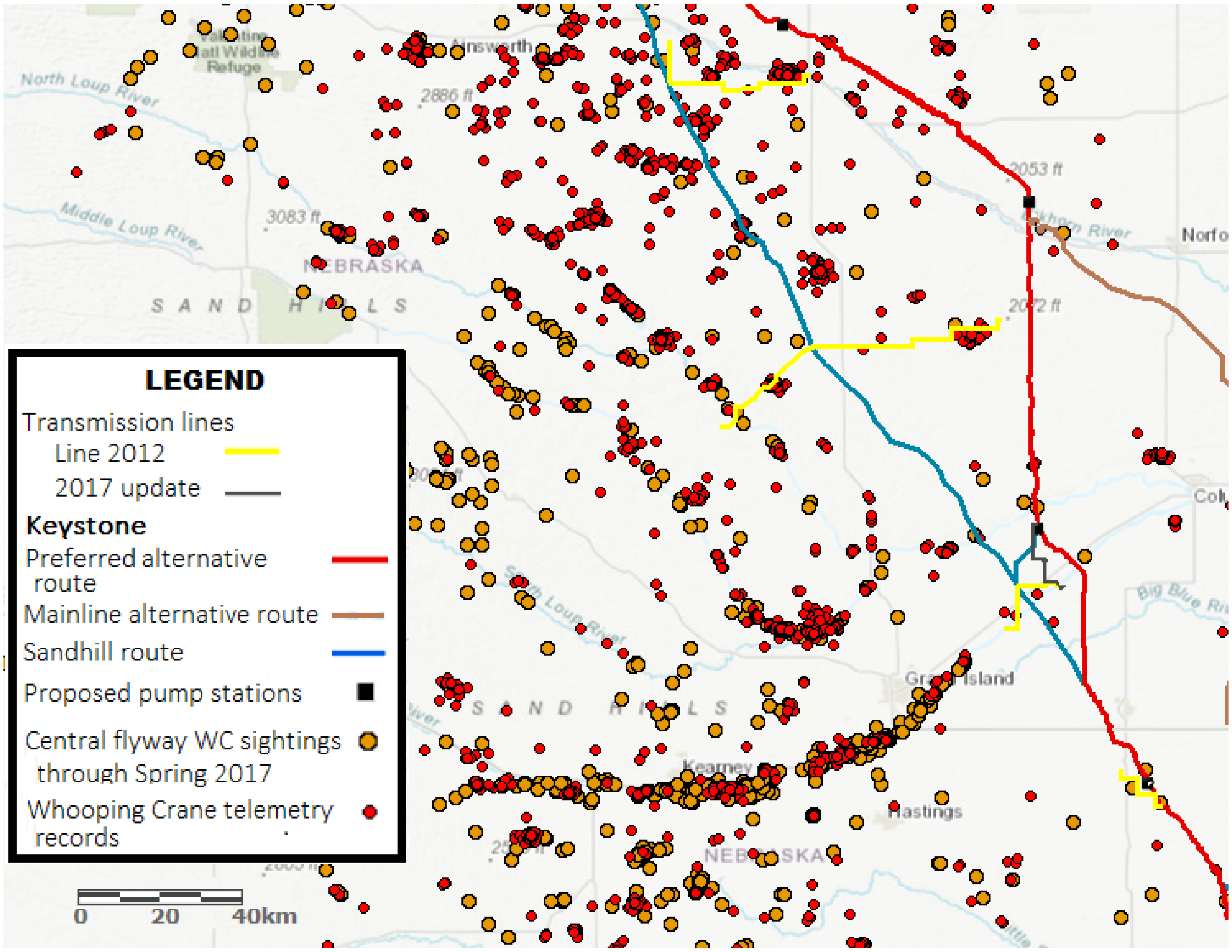

Figure 4: Whooping Crane USFWS historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of Keystone XL project power lines in Nebraska. Note that proposed pump stations (black squares) for the Preferred Alternative are located very close to Whooping Crane data points. The power line locations depicted on this map are for the initial Keystone XL route through the Nebraska Sandhills region. This route was subsequently changed (to the "Preferred Alternative") prior to the State Department's review of the Project in the Biological Assessment; however, no information on the location of power lines for this route in Nebraska was available when the State Department and Service conducted the ESA Section 7 consultation. This map shows the proposed pump station locations for the Preferred Alternative (black squares), and this along with the proposed power line locations for the Sandhills route was the only specific information for Nebraska that was available at that time of the USFWS review in 2013.

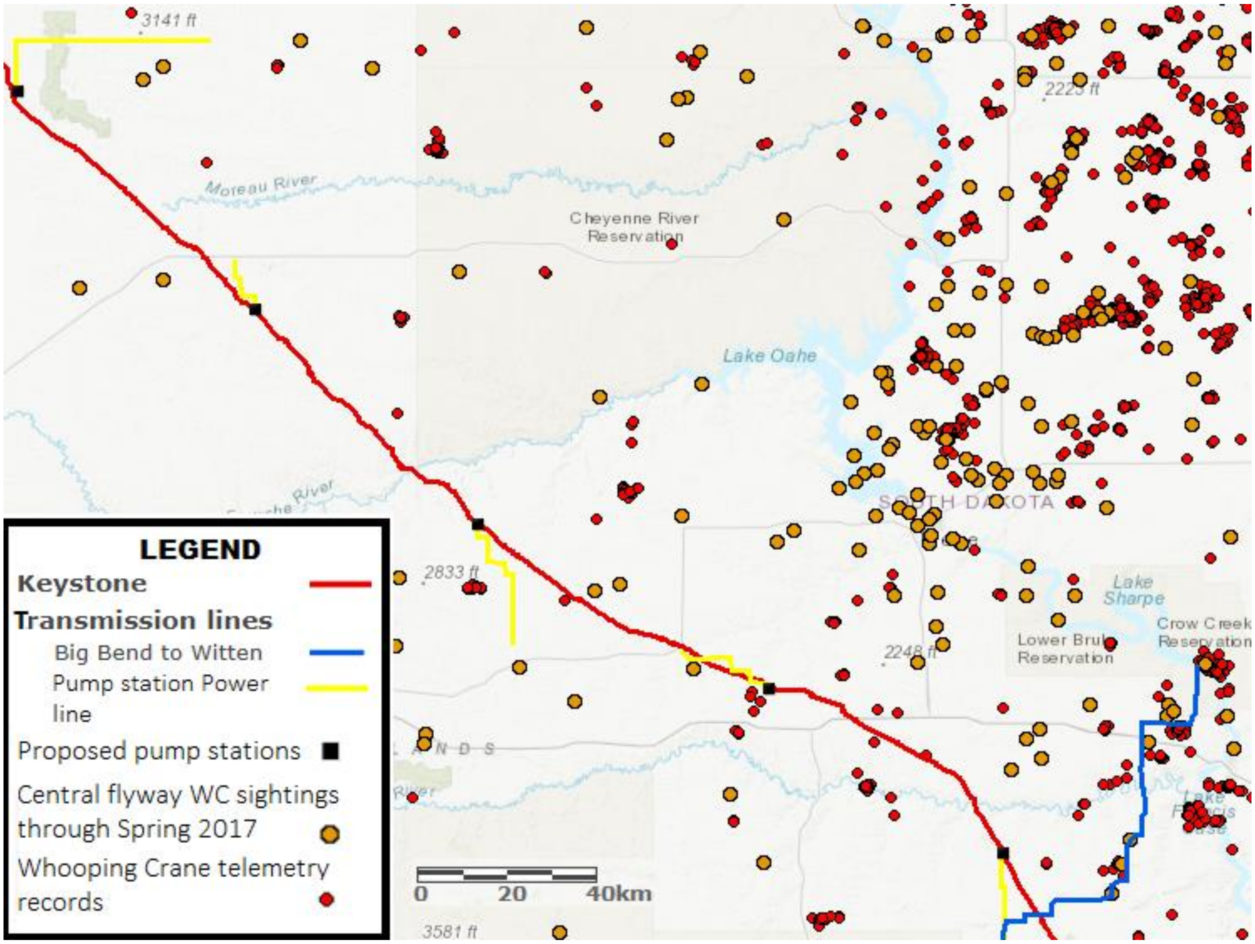

Figure 5: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of Keystone XL project power lines in South Dakota. Note that proposed powerlines (yellow lines) and pump stations (black squares) are located very close to Whooping Crane stopover habitat.

It is important to note that while the telemetry and sighting data are the best available data on the species, relying solely on this data to identify stopover locations where cranes would be at risk of collisions severely underrepresents the risk to the species from this Project. The data is useful, but is still limited. For example, the telemetry data only tracks the movements of 20% of the Whooping Crane population, and therefore does not identify all habitat areas that cranes are relying on. Likewise, the historical sighting data is limited to those areas where the public may view these birds, and much of the migratory corridor has very low populations (so few opportunities for sightings) and/or is private land that the public cannot even access. The vast majority of Whooping Cranes stopping to roost at stopover sites in the migratory corridor are not observed and/or reported. Therefore the observational data base and telemetry data represent an unknown percentage of the stopover habitats that have been used in the last few decades. In fact, the telemetry data has provided us with areas that we now know cranes habitually rely on, but which were not captured by the historical sighting data. Therefore, the risk to the species is

actually underrepresented by this data, and our analysis of the potential for harm is very conservative.

2. Proximity of Whooping Cranes to Keystone XL Power Lines and Associated Collision Risk in Nebraska, South Dakota and Montana

In this section, we show specific proposed power line locations where there is substantial historical Whooping Crane activity. When we compare the Whooping Crane sighting and telemetry data to the proposed power line locations, it is readily apparent that the proposed power lines pose a significant risk to cranes, given the historic use of the area. Some of these cases are good examples of site fidelity, since the data shows the same banded individuals returning to the same stopover location during different migrations. Because these birds are likely to return to this historic stopover location, there is a high likelihood that they will be landing and taking off in close proximity to a power line if the Project is constructed, creating a high risk of collision. This is especially the case if they are landing during high wind or low visibility conditions, when the line is less visible, and the birds may have trouble controlling their flight.

For Nebraska, we have provided maps showing the proposed power line locations for the original Sandhills route, which is the initial route that was later changed by TransCanada (to the "preferred alternative") in order to avoid the sensitive Sandhills ecoregion. While these proposed power line locations may have changed, no updated information on the power lines for Nebraska has been made available. We were provided with updated power line location information from maps included in the administrative record in this matter for the "preferred route"; however, these maps did not provide updated information for the power line locations in Nebraska.[10] For the preferred alternative route in Nebraska, only the location of the proposed pump stations was available; however, since several of these pump stations are in the vicinity of the power line locations that were proposed for the Sandhills route (as shown on the maps below), we can assume that the power companies are likely to propose lines in similar areas for the preferred alternative. We have therefore provided maps for Nebraska showing the only power line location information available. For South Dakota and Montana, the maps show the most current information on proposed power line locations (the 2012 information along with 2017 updated data).[11]

[10] It is our understanding, then, that TransCanada and the power providers in Nebraska have never provided any detailed information on the proposed locations of the power lines serving pump stations 22, 23, and 24 for the preferred alternative route as shown in the Biological Assessment.

[11] We understand that the Nebraska Public Service Commission has now approved a different route, and therefore these power line locations are still not final; however, this is the best available data we have for the location of the Project.

Nebraska

There are two specific areas in Nebraska near the proposed power line locations (for the Sandhills route) where there is a very high potential for harm to cranes. One of the proposed power lines, located in Holt County, is in close proximity to 231 Whooping Crane data points as shown in the telemetry records (Fig. 6). These data points are distributed in three main clusters around the Elkhorn River and adjacent fields, and they represent movements from seven radio-tracked individuals. The map also shows seven USFWS Whooping Crane historical sightings in the proximity of the power line. The main cluster (close to the town of O'Neill) is critical because all the Whooping Crane records are located from 0 to 2.5 miles from the projected power line location. Based on this data, there can be no doubt that placing a power line at this location would have been highly likely to result in a collision, and therefore would have significantly increased the risk of harm to Whooping Cranes.

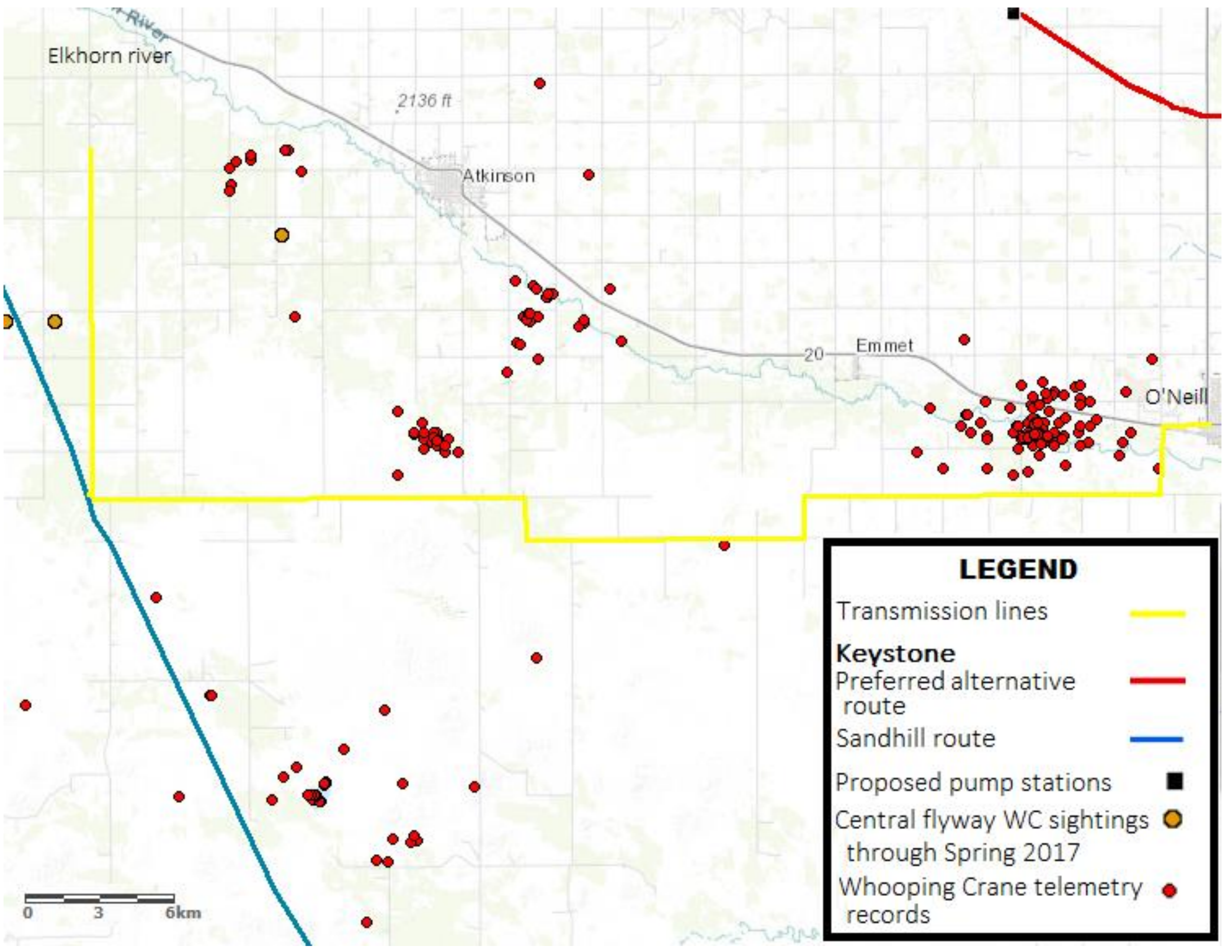

Figure 6: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of proposed Keystone XL project power lines for the Sandhills Route in Holt County, Nebraska. The map shows 231 records from seven Whooping Cranes tracked in telemetry project and seven USFWS historical sightings in the proximity of the power line. Note that proposed powerlines (yellow lines) and pump stations (black squares) are located very close to the Whooping Crane habitat.

The second critical area for the original proposed power line locations in Nebraska is a power line in Valley, Wheeler, and Boone counties, where 143 Whooping Crane telemetry data points are in close proximity to the proposed power line location (Figure 7), representing the movements of 5 tracked individuals. The map also shows 10 USFWS Whooping Crane historical sightings in the proximity of the proposed power line. The two main hot spots were registered around wet meadows and agricultural fields. The first is around the Beaver creek segment and small wetlands, from 0 to 3 miles from the projected power line, close to the town of Petersburg (Boone County). The second cluster was observed at agricultural fields and small ponds from 0 to 2 miles from the proposed power line, northeast to the town of Ord (Valley County). Again, based on the available Whooping Crane data, it is clear that the initial proposed power lines for this Project were to be built directly in the path of migrating cranes and in areas they use as stopover habitat during migration, posing a significant threat of collisions.

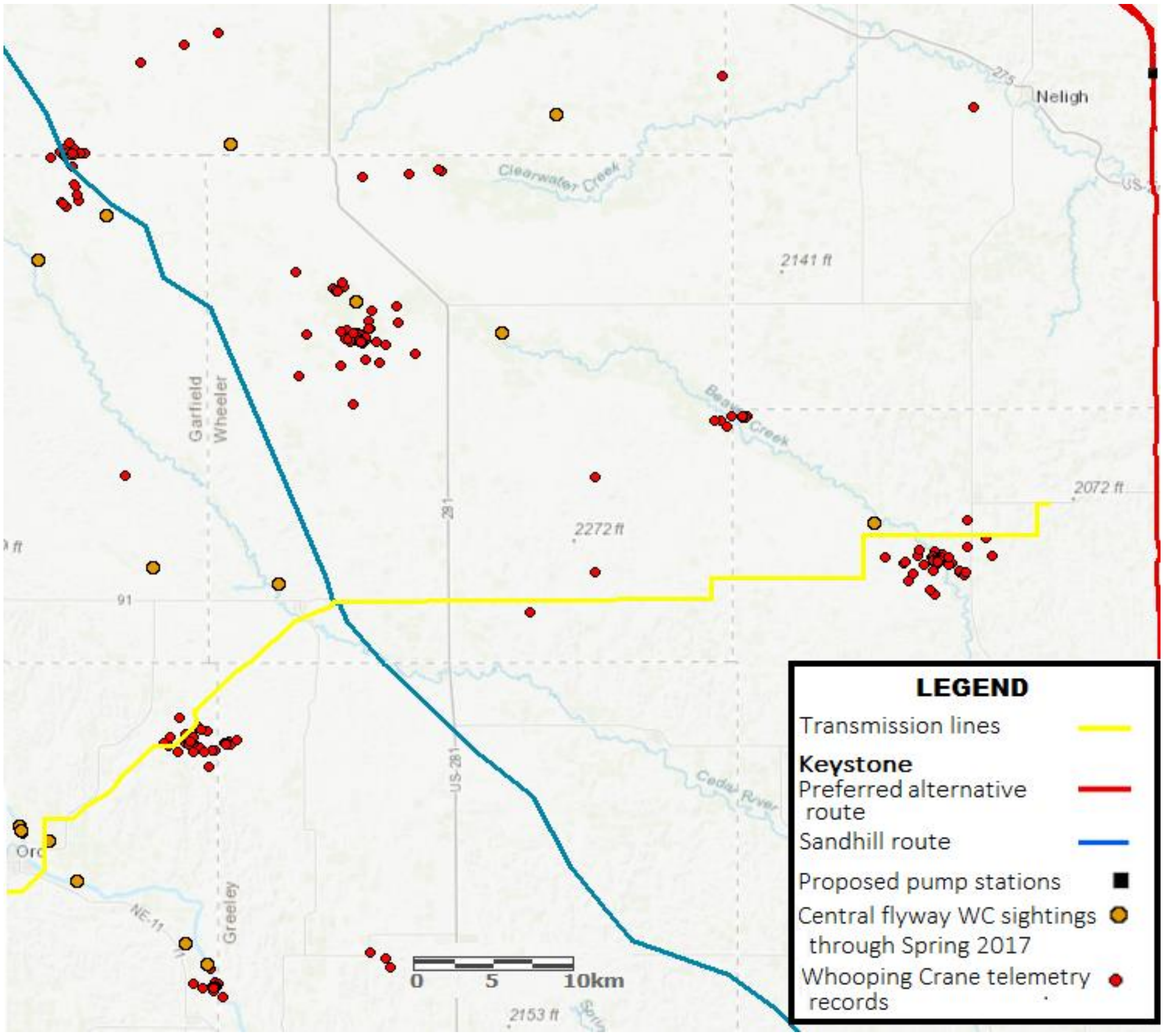

Figure 7: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of Keystone XL project power lines in Valley, Wheeler, and Boone counties, Nebraska. 143 Whooping Crane data points are in the proximity of this proposed power line. Note that the proposed powerlines (yellow lines) are located very close to Whooping Cranes.

Other areas in Nebraska showed lower levels of crane activity, but these still contain sufficient data points to warrant concern. For example, Fig. 8 below shows four Whooping Crane telemetry records from four radio-tagged individuals in the area where a power line was originally projected in Merrick and Hamilton counties. Three of these records are located close to the Platte River and one of them in an agriculture field. Although this location represents few records, it must be remembered that each data point may represent several cranes, and therefore the risk of collisions at this location is still significant. Moreover, the Platte River is one of the main hotspots for Whooping Crane sightings during spring and fall migration, so this power line should have been considered a critical location because cranes will return to this area and be susceptible to colliding with the power lines. The map also shows three USFWS Whooping Crane historical sightings. These sightings, and one sub-sighting, are located just 0.5 to 1.97

miles from the proposed power line location.

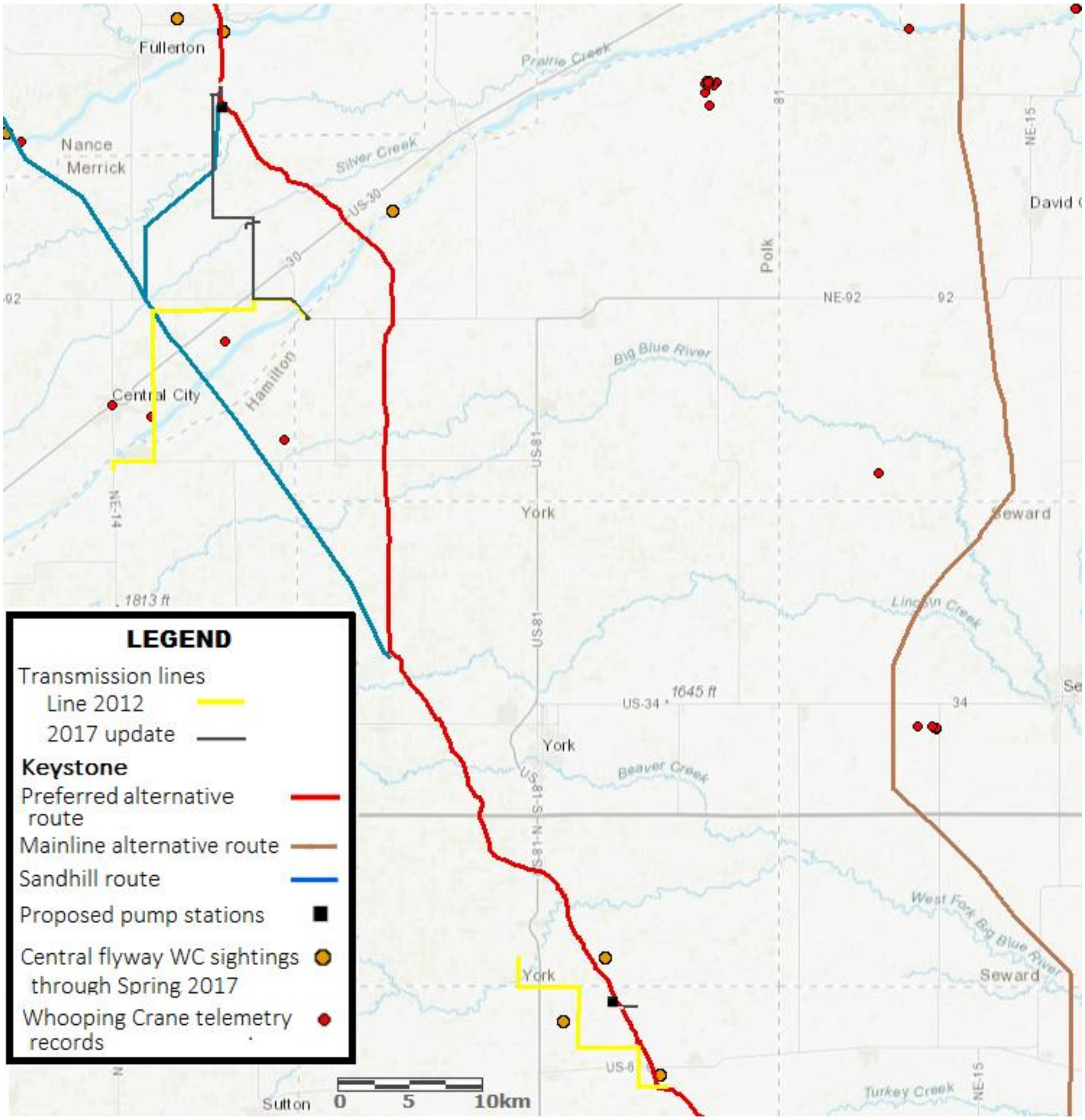

Figure 8: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of proposed Keystone XL project power lines for the Sandhills Route in Merrick and Hamilton counties, Nebraska. The map shows 4 records in the proximity of the projected power line. Note that proposed powerlines and pump stations are located very close to Whooping Cranes.

South Dakota

The potential for Whooping Crane collisions with Keystone XL power lines is also apparent in South Dakota.[12] At one power line (the Big Bend to Witten 230-kV Transmission Line - Figure 9), the map shows 231 Whooping Crane telemetry data points near the proposed power line in Tripp and Lyman counties, which represents the movements of 15 radio-tagged individuals. The map also shows 10 USFWS Whooping Crane historical sightings in the proximity of the proposed power line. The main cluster of records was registered in proximity to the Buffalo River and nearby meadows and agricultural fields from 0.5 to 4.5 miles from the proposed power line, south of Fort Thompson. Another cluster of Whooping Crane telemetry records appears east of Reliance, and is distributed between agricultural fields and a creek, from 0.3 to 2 miles from the proposed power line. A third cluster of records, in the south section of the proposed power line and south of Hamill, is distributed from 0.4 to 1.2 miles from the power line.

[12] The power line locations depicted for South Dakota are from the most recent (2017) power line maps that were provided by USFWS in the administrative record in this matter.

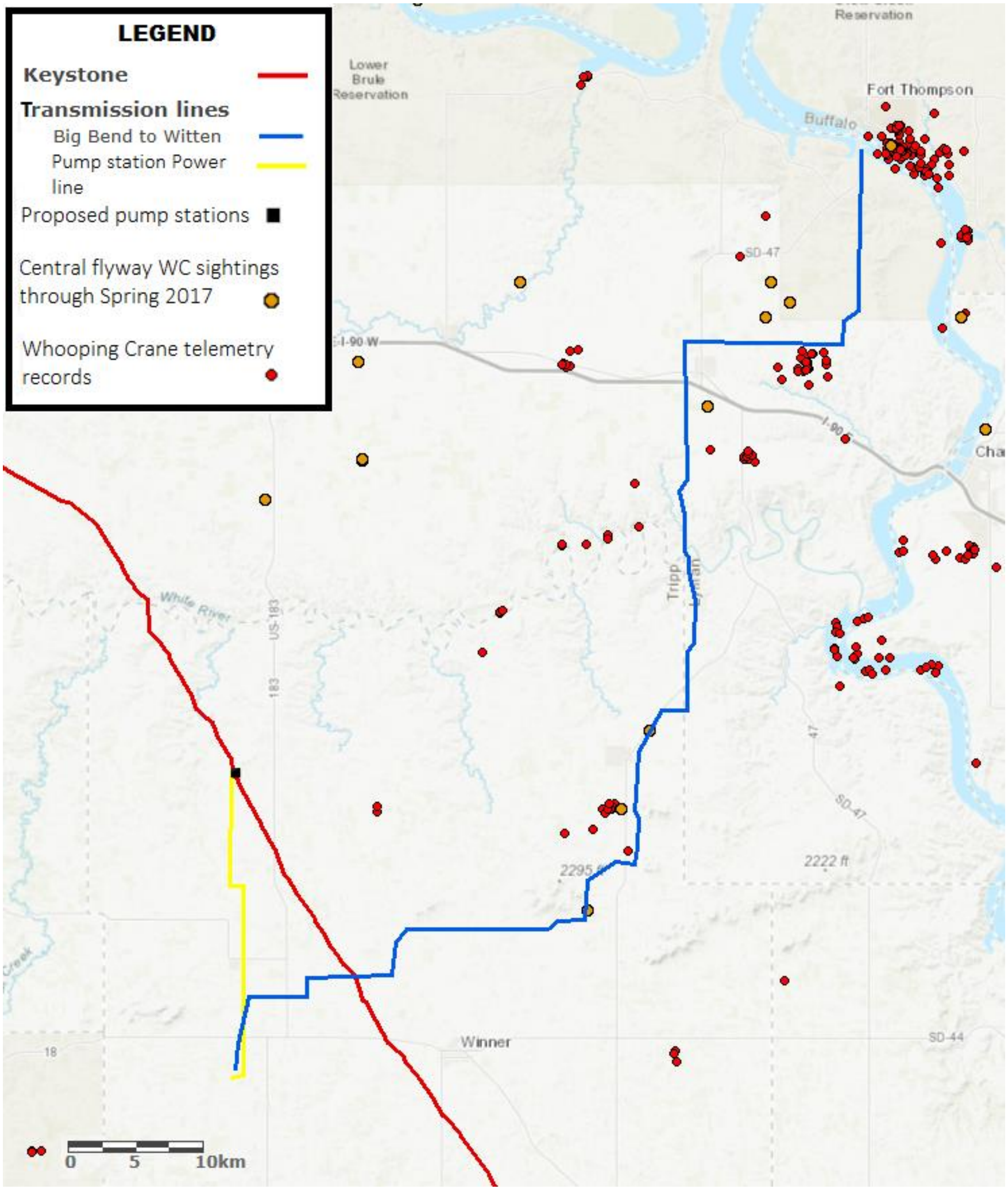

Figure 9: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of the Big Bend to Witten 230-kV Transmission Line that is part of the Keystone XL project in South Dakota. The map shows 231 Whooping Cranes telemetry project records from 15 radio-tagged individuals and 10 USFWS Whooping Crane historical sightings in close proximity to the power line.

This proposed Big Bend to Witten power line is particularly problematic for cranes. One of the clusters is just below the line where it would run east-west, north of I-90. Here, the power line would be constructed in a zig-zag pattern, with a right turn that takes the line just north of the Whooping Crane data points. That location creates a potential trap for cranes since they may be hemmed in on several sides by power lines, putting them at high risk of collisions as they land or take off from this stopover location and making this area particularly dangerous. Based on this data, and the proximity of crane records to the proposed power line location as well as the shape of the line, it is our opinion that this location poses a very high risk of collisions, and it is more than likely that several collisions would occur here over the 50-year life of the Project. Based on this data, there can be no doubt that placing a power line at this location is highly likely to result in a Whooping Crane collision.

Other proposed power line locations in South Dakota also show a risk of collisions. In the area where two power lines are projected in Haakon and Jones counties, there are 21 and 14 Whooping Crane telemetry data points, respectively, in proximity to the proposed lines (Fig. 10), which represent the movements of several groups of tracked individuals. The map also shows two USFWS Whooping Crane historical sightings in the proximity of these power lines.

All of these records are located mainly in wetlands and creeks, and while they are not directly adjacent to the proposed power lines, it is very possible that birds landing on their way south or taking off to the north from these areas would be exposed to the power lines. If this occurred during low light or high wind conditions, the risk of collision would be very high.

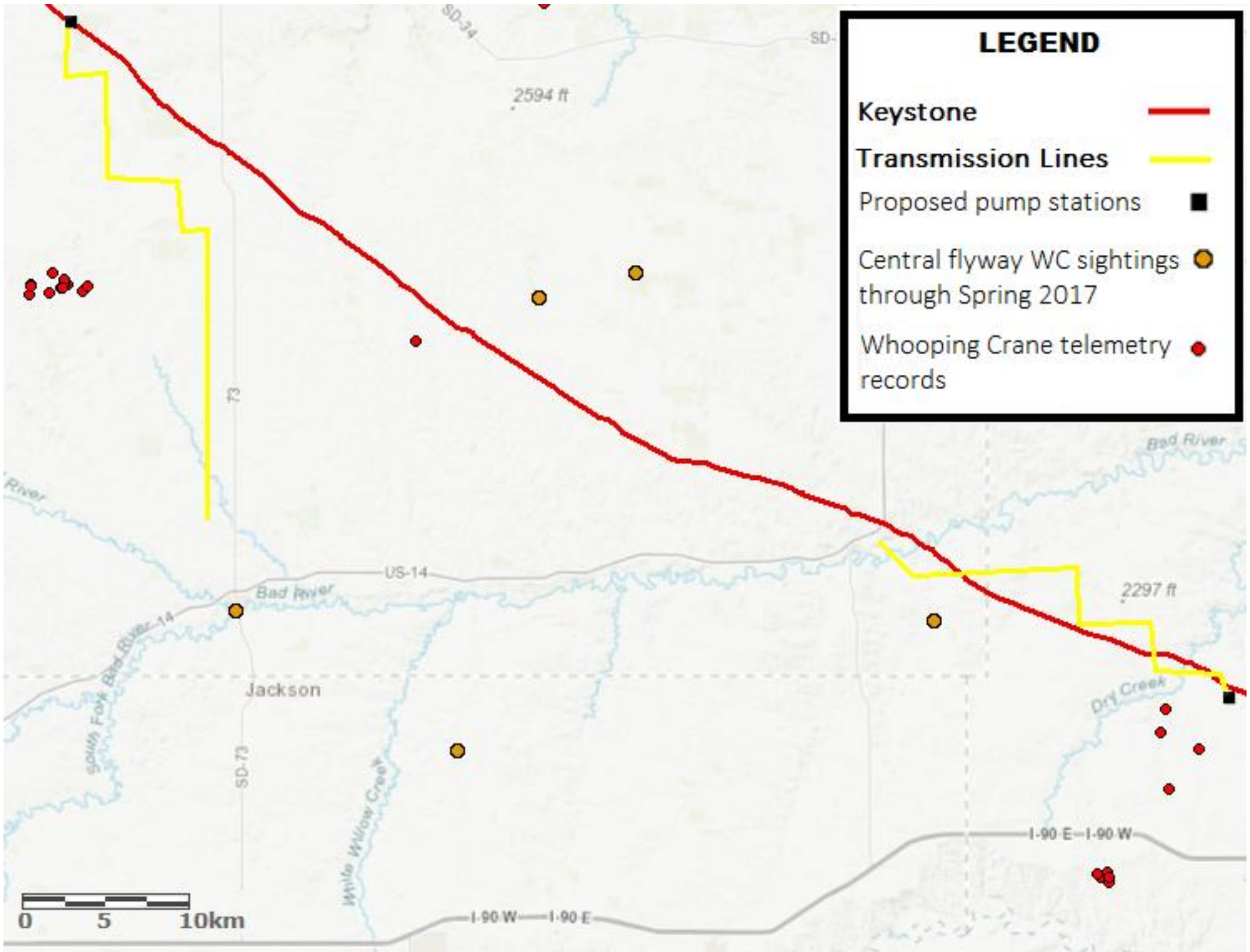

Figure 10: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of Keystone XL project power lines in in Haakon and Jones counties, South Dakota. The map shows 14 and 21 Whooping Crane historical and telemetry records, respectively, from 1.5 to 8.5 miles from the proposed power lines. The map also shows two USFWS Whooping Crane historical sightings in the proximity of these power lines.

In northwest South Dakota, in Harding and Perkins counties, there is another proposed power line where Whooping Cranes could be harmed (Fig. 11). Three Whooping Cranes records (1 from the telemetry data and 2 from USFWS historical sightings) were located from 4.2 to 6.7 miles from this proposed power line. As with the lines above, birds landing on their way south or taking off to the north from these areas would be exposed to the power line, risking collision.

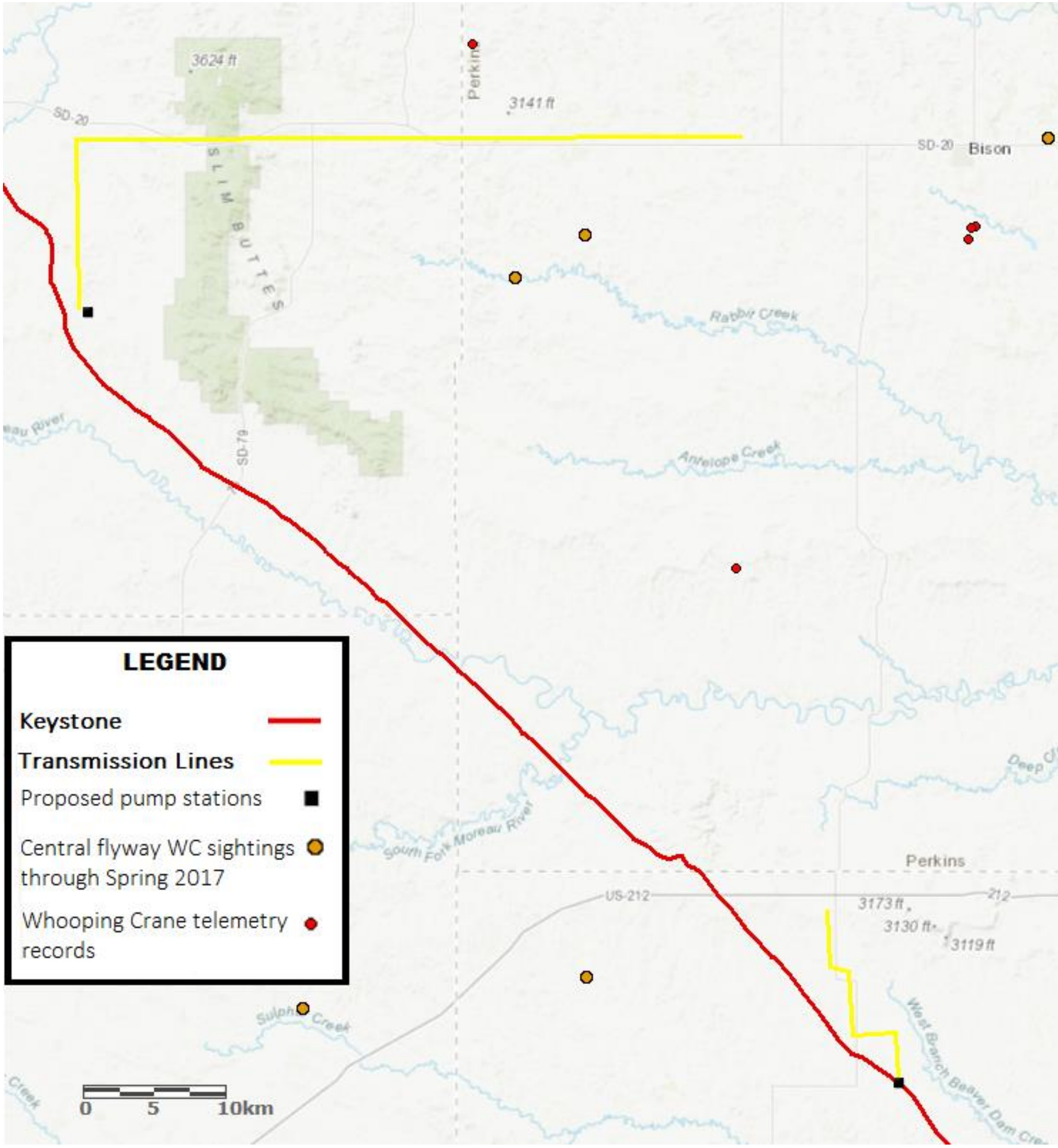

Figure 11: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of a Keystone XL project power line in Harding and Perkins counties, South Dakota.

Montana

Whooping Crane collisions with proposed Keystone XL power lines are also possible in Montana. While many of the pump stations in Montana are outside the delineated migratory corridor, in three areas close to the Keystone XL proposed power lines the map shows four Whooping Crane stopover locations from the USFWS historical sighting data, located from four to eight miles away, respectively (Fig. 12). These locations may pose a smaller risk of collisions than some of the other proposed power lines, but they still increase the likelihood of harm during migration.

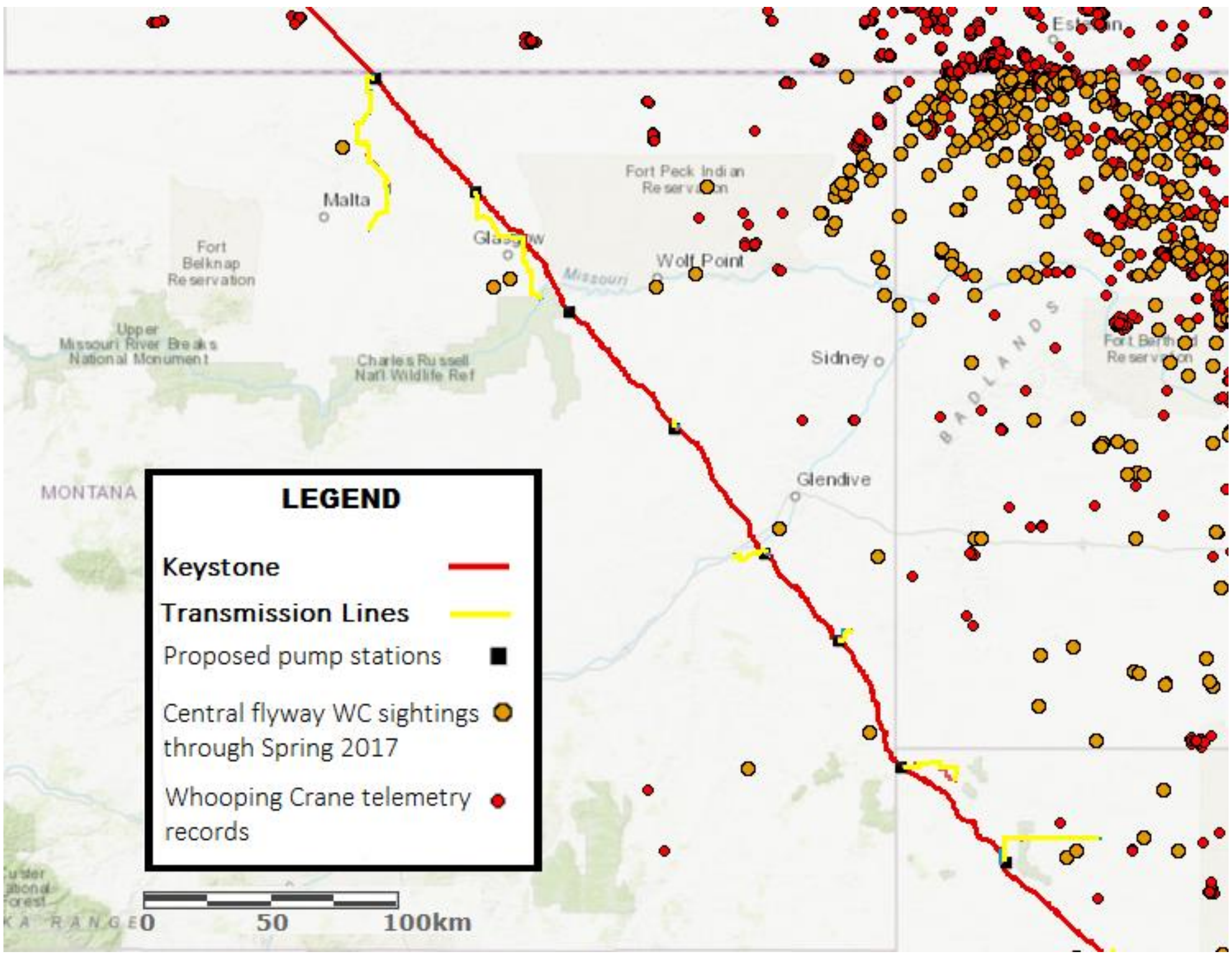

Figure 12: Whooping Crane historical sightings (orange dots) and telemetry project records (red dots) located in the proximity of Keystone XL project power lines in Montana. The data shows four Whooping Crane records, from 4 to 8 miles from the proposed power lines.

Summary

In sum, using USFWS's historical records and the Whooping Crane Tracking Partnership telemetry data to identify specific habitat areas used by cranes during migration provides essential information as to the potential impacts to the species. Our analysis of the historical and telemetry data shows 68 individual Whooping Cranes with 704 data points in close proximity to the proposed pump station power lines for the Keystone XL project. This indicates that the likelihood a Whooping Crane will collide with a power line is very high.

The telemetry records actually underestimate the real number of daily movements that would expose Whooping Cranes at their stopovers to collisions. Furthermore, the telemetry data shows that a number of radio-tracked Whooping Cranes have stopped in the Project area at least two or more years, roosting on wetlands and river habitats, and feeding in adjacent areas, indicating site fidelity. During migration, when the risk of collisions with power lines and other man-made objects is much higher, the brief time that Whooping Cranes pass through each stopover is not enough to ensure predictable conditions, and only the crane's site fidelity helps reduce the risks during the uncertain and dangerous migration by allowing the cranes to rest in areas they have previously relied on. This pattern of habitat use by Whooping Cranes, with specific stopover habitat used over generations, puts cranes at significant risk when those areas coincide with the Project, because the cranes are almost certain to return to these areas where they will then be subject to a much higher collision risk. Our maps show the overlap of USFWS historical stopovers with clusters of recent telemetry stopovers, supporting our observation that these areas have been used by Whooping Cranes during many migrations.

Furthermore, while the potential for collisions at the power line locations is relative to the proximity of the power lines to crane habitat, the lines do not need to go directly through a wetland or forage site to pose a risk. After flying upwards of 400 kilometers between stopover sites, Whooping Cranes often stay in one area, resting and making short flights between roosting and feeding habitat. The area that the cranes use during these stopovers can be ascertained from the telemetry data, to gauge the size of the crane's stopover habitat—what we call the "home range."

Our analysis indicates that there are places where the Keystone XL power lines may divide wetlands used for roosting from grain fields used for feeding, and therefore pose a high risk of collision by placing a transmission line in areas frequented by Whooping Cranes, as shown through the telemetry data.

A major component of the USFWS Whooping Crane Recovery Plan involves reducing mortality during migration and removing habitat constraints that might limit recovery (USFWS 1994). The USFWS avers in the Recovery Plan that "additional power line construction, throughout the principal migration corridor, will undoubtedly increase the potential for collision mortalities," suggesting that new power line corridors should avoid wetlands or other Whooping Crane high-use areas.

It is evident from the historical and telemetry data that this Project presents a significant risk of collision harm. Given the location of the proposed Project across the migratory corridor and the historical use of the proposed power line areas by Whooping Cranes, and the fact that it has been documented that power lines are the greatest cause of mortality for migrating Whooping Cranes, it is our opinion that this Project will result in harm to Whooping Cranes, and that such harm could jeopardize the continued existence of the species since it is so critically endangered. There can be little doubt from the available data that this Project poses a significant risk to Whooping Cranes.

E. Bird Flight Diverters Will Not Prevent Harm To Whooping Cranes

Our analysis indicates that the proposed Project would harm Whooping Cranes through collisions and is likely to result in several, and potentially dozens (i.e. multi-bird collision incidents), collisions over the life of the Project. Pursuant to the State Department's Biological Assessment and USFWS's concurrence, it is our understanding that these agencies are relying primarily on the use of bird flight diverters to mitigate the risk of such collisions; however, their reliance on these devices is entirely misplaced, as these devices will not prevent all collisions. It also remains unclear whether (or where, precisely) the power line providers will be required to install these devices, and USFWS has provided no analysis as to their efficacy for this Project.

Moreover, the scientific literature on bird flight diverters indicates that they may only be up to 50% effective generally (APLIC 2012), and can thereby reduce, but will not eliminate the risk of collisions. However, recent studies indicate that cranes in particular may not be able to see these devices in time to allow them to effectively avoid collisions, and therefore bird diverters would be even less effective for this species.

While we acknowledge that the USFWS Region 6 Guidance on Power Line Development in Whooping Crane Habitat suggests that bird diverters "could reduce the potential" for collisions to a discountable level, this guidance is outdated and unsupported by sufficient scientific data. Bird flight diverters will not be sufficient to avoid Whooping Crane mortality due to power line collisions for the following reasons:

- Even if bird diverters are conspicuous to human observers and located in open habitat, it may be difficult for cranes to see them. The information that birds extract visually from their environment can be quite different from that extracted by humans in the same circumstance because there are differences between humans' and birds' vision, such as relative depth, distance, and time to contact, as well as field of view (Martin and Shaw 2010). From an anatomical perspective, the evidence and arguments reviewed suggest that bird collisions may be the result of both visual and perceptual constraints. For example, cranes have a comprehensive visual coverage of the hemisphere in front of the head extending only 80 degrees vertically, giving these birds extensive blind areas both above and below the head in the frontal hemisphere (Martin and Shaw 2010). This makes it hard for them to see bird flight diverters and suggests that they are much less than 50% effective for cranes (most studies find diverters to be 50% effective generally, but that is for all bird species).

- Cranes are looking down while flying, searching for foraging patches and roost sites. The birds are more interested in what is below them than what lies ahead in the (presumed) open airspace (Drewitt and Langston 2008, Shaw 2009, Jenkins et al. 2010). Whooping Cranes are a species that prefers open landscapes with little or no natural tall vegetation in its surroundings; therefore, it did not evolve having to navigate and/or avoid elevated structures such as power lines in its natural landscape. Cranes are therefore not often looking forward for obstacles, and may not see power lines or bird flight diverters, resulting in collisions even when the line would be clearly visible to a person. Cranes therefore have less opportunity to see diverters, and therefore they are less effective for this species than other species.
- Cranes have a restricted range of flight speeds and some collisions may occur when visibility is reduced due to lower light levels or weather conditions such as rain or fog. These conditions reduce the amount of visual information as well as the ability of the crane to control its flight. Several Whooping Cranes have moved during dark hours and hit power lines (Kuyt 1992). Conditions such as high-velocity winds have even been shown to buffet whooping cranes into "fully visible power lines with which they are quite familiar, but which they cannot avoid because they cannot maintain flight control." (Stehn 2008).
- Despite more than 30 years of using markers on power lines, such as reflective balls, flapping flags, and wire coils designed to increase the probability of their detection from a greater distance, the probability of mortality caused by power line collisions remains high for crane species, and we do not have a single effective way to reduce collisions, as evidenced by the fact that power line collisions remain the greatest threat to Whooping Cranes. Several studies have therefore concluded that these devices are below the limit of visual resolution and/or are not seen until well after the point at which larger birds, like cranes, can react in time to avoid the lines (Bevanger 1994, Janss and Ferrer 1998, Janss and Ferrer 2000, Drewitt and Langston 2008).
- Because groups of Whooping Cranes follow a leader, the larger the group size of cranes flying together the greater the risk of one or several of them colliding with a power line, as the followers are less attentive to unexpected obstructions. Because of the Whooping Crane's morphology and social behavior on migration, they are not able to adapt or change their behavior to cope with recent man-made structures now present in their habitat and will therefore continue to be susceptible to collisions with power lines. This poses a significant threat to the continued existence of the species.

It is therefore apparent that even with the use of bird diverters, this Project is more than likely to result in power line collisions, as discussed above.

Furthermore, it remains unclear from the State Department and USFWS assessments where precisely the diverters would be placed, and there is insufficient information on how the State Department and USFWS would determine which areas the power line providers would mark. As Whooping Cranes make short flights between feeding and foraging areas (up to 8 miles), they

can collide with power lines simply because they do not see them and/or cannot maneuver quickly enough to avoid the impact. Therefore, the proximity of power lines to locations where birds are landing and taking off is critical (USFWS 2009). Without knowing where these devices would be placed, which the State Department and USFWS have not specified, it is not possible to assess how or whether they will be effective at all to even reduce the risk of collisions.

F. <u>Impacts To Whooping Cranes From Habitat Disturbance</u>

The Whooping Crane historical sighting and telemetry data further indicate that construction and operation of Keystone XL would harm cranes through habitat disturbance. Temporary disturbance from construction of the Project as well as long-term habitat disturbance from the placement of access roads and power lines in the central flyway is likely to result in harm to Whooping Cranes beyond the risk of collisions. Alterations to the crane's habitat will produce an unpredictable response, even at small scales. Even minor changes to the landscape can harm Whooping Cranes. From an aerial perspective, access roads and other infrastructure may represent a major modification of the landmarks used by cranes as reference points to memorize their stopover sites. New infrastructure, such as roads, buildings, or towers, or modification of landscape features, could represent a major alteration and/or disturbance, pushing them away from their historical stopover locations or predetermined destinations. This can cause stress and harm cranes, as discussed further below.

The historical sighting and telemetry data indicates that at least 68 Whooping Cranes utilize habitat areas very close to the Keystone XL route (within two miles or less), and there have been around 704 telemetry data points in the Project area, showing widespread use of multiple areas in the vicinity of the Keystone XL route. Again, the number of cranes using these areas is likely much higher, since only 20% of the population was radio-tagged, and they often travel in flocks. While the State Department and USWFS may claim that Whooping Cranes will not be harmed by the Project because they will avoid the line and utilize other available habitat in the vicinity of the Project, this ignores the site fidelity that Whooping Cranes exhibit, and the harm that will be caused by the disruption to their migratory patterns.

The historical sighting data as well as the telemetry data indicate that cranes show site fidelity along the central flyway. For generations, pairs of Whooping Cranes and their descendants have relied on the same wetlands along the migratory route (Gil et al. 2014). In fact, the identification and use of stopover habitat is a learned behavior transmitted from generation to generation (Gil et al. 2014). Data and observations show flocks of as many as 21 individuals arriving at the same wetland, which could be an indicator that all of them are related, and show that using that particular wetland is an inherited tradition (Gil and Weir, 2012). Therefore, even minor changes to the landscape that could alter the ability of the cranes to identify or utilize their historic stopover locations could affect several individual birds and create a harmful risk to the species.[13]

[13] Furthermore, if TransCanada intends to restore habitat after construction to provide mitigation

The State Department and USFWS also failed to account for the risk of harm from the crane's reaction to construction activities, which will produce an unpredictable reaction that could harm cranes. For example, if a crane (or extended crane family) arrives at its historical stopover area and is confronted with construction activities (or equipment) or a power line in its path, it will likely have to search for a new roost, and this would cause stress and further deplete the birds' energy resources during the long and dangerous migration. Even if construction is halted, the presence of workers and equipment would potentially scare the cranes off. This could also cause the birds to start a search for new roosts when light conditions are suboptimal, leading to increased risk of collisions, and may result in the crane landing in fragmented habitat, with insufficient food and water resources and higher predation risk.

For example, Whooping Cranes arriving in the afternoon to their known stopover, after flying up to 400 kilometers non-stop, are in dire need of rest, and would be adversely impacted by construction personnel and noise disturbances or the presence of new power lines (if they can see and avoid them), forcing them to find an alternate site. Needing to find another suitable wetland, in potentially low visibility conditions, poses a significant risk of collision, and creates additional stress that may harm the cranes. The resulting harm will depend of the remaining energy that Whooping Cranes will need to make an extra flight or flights to search for food, roost, and prevent predation (Chavez-Ramirez 1996). Whooping Crane migratory behavior suggests that much of it may be directed at saving energy reserves while en- route (Chavez-Ramirez 1996). Each day spent in migration is one more day of energy expenditure that will diminish the total energy reserves available at the time of arrival in the breeding grounds. Therefore, cranes will not easily move to other available habitat without consequence, and the impacts to cranes from the loss of hereditary stopover areas have not been fully considered by the State Department or the Service.

CONCLUSION

The Aransas-Wood Buffalo Whooping Crane population has grown from around 15 individuals in 1941 to just over 300 individuals; yet even with this growth, the species remains far from the numbers that are needed to protect the species. It is well established that collisions with power lines are a substantial cause of Whooping Crane mortality during migration and a significant threat to the species (Brown et al. 1987, Lewis et al. 1992, Stehn 2008).

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for impacts to whooping crane habitat, it is our opinion (based on our experience) that Whooping Crane habitat cannot be "restored" to similar conditions. In fact, the Whooping Crane Maintenance Trust made several attempts to restore Whooping Crane habitat with the same shape and substrate; however, Whooping Cranes did not respond in those areas in the same way, and therefore it may not be possible to restore habitat with the same functions and values that Whooping Cranes rely on. (Ramirez-Yanez et al. 2011).

Based on our work with Whooping Cranes over the past 15 years and using the historical sighting records and telemetry data to assess the likelihood of harm, it is our opinion that construction and operation of Keystone XL is more than likely to result in several Whooping Crane collisions over the life of the Project and to harm cranes through habitat modification. Moreover, the harm to the Whooping Crane population associated with this Project will undermine recovery efforts and risk the continued existence of this iconic species.

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APPENDIX A

CURRICULUM VITAES

KARINE C. GIL, Ph. D.

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EDUCATION

Post-doctoral Research in Ecology. 2005-2006. The Royal Swedish Academy of Sciences. The Beijer International Institute of Environmental Economics, Stockholm, Sweden. Research: Ecological functions and economic value of a migratory cormorant population: A model of ecological interactions with fisheries.

Ph.D. in Ecology. 2006. Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX, USA. PhD Dissertation: Whooping Crane (*Grus americana*) demography and environmental factors in a population growth simulation model. 159pp.

Master of Science in Applied Ecology. 2000. Experimental Science Faculty, Universidad del Zulia, Maracaibo, Venezuela. Thesis: Neotropic Cormorant (*Phalacrocorax brasilianus*): Abundance and diet in the Los Olivitos Estuary Wildlife Refuge and Fisheries Reserve, Venezuela. 82pp.

Bachelor's Degree in Biology (Five-year program, with B.S. Thesis). 1984. Department of Environmental Studies, Universidad Simón Bolívar, Caracas, Venezuela. Thesis: Reproductive Biology of the Carib Grackle (*Quiscalus lugubris*). 134pp.

Degree in Piano Teaching and Performance. 1983. National Conservatory of Music, J. J. Landaeta, Caracas, Venezuela.

RELEVANT WORK EXPERIENCE

Ecosystems Advisors LP. Ecologist, Project Coordinator and Researcher. Mar. 2011 to present. College Station, TX.

- Integrated Crane database manager for the wild Whooping Crane population, and Crane Speaker for NGOs.

INQUIRE ACADEMY, Gifted and Talented Children Program. Biology teacher. Aug. 2016 to present. College Station, TX.

Texas A&M University, Department of Biology. Biology Lab Instructor. Aug. 2013 to June 2016. College Station, TX.

Blinn College. Biology Instructor. Aug. 2011 to July 2013. Bryan, TX.

Ecosystems Advisors, LP. Ecologist Project Coordinator. May 2011 to April 2012. Texas.

- Whooping Crane historical sightings database and habitat use for the Platte River Recovery Implementation Program, Nebraska. Director: Jerry Kenny, Ph.D.

The Crane Trust. Population Ecologist-Avian Biologist. Jan. 2007 to May 2011. Wood River, NE.

- Ecologist of Sandhill Crane and Whooping Crane populations. Research on habitat use by cranes in Nebraska and along the central flyway and environmental factors affecting crane populations.
- Conducted long distance migratory bird population simulation models. Provided technical advice for a new migratory bird banding effort. Participated in coordination of the Whooping Crane Conservation Action plan.
- Acted as the Whooper Watch program coordinator.

The Royal Swedish Academy of Sciences, The Beijer International Institute of Environmental Economics. Visiting Ecologist. Dec. 2005 – Nov. 2006. Stockholm, Sweden.

Texas A&M University, Wildlife and Fisheries Sciences (WFSC) Department, System Ecology Laboratory. Graduate Research Assistant. Jan. 2003 – Nov. 2005. College Station, TX

- Focus on Whooping crane ecology, energetic budget, demography, and effects of environmental factors on population dynamics.

Texas A&M University, Texas Cooperative Extension, WFSC Dept., and Texas Water Resources Institute. Researcher. Jan. 2003 – Dec. 2004. College Station, TX.

- Spatial relationships of aquatic bird species, irrigation systems, water reservoirs and natural areas in the Lower Rio Grande Basin.

Texas A&M University, Texas Cooperative Extension; WFSC Dept. and Texas Water Resources Institute. Researcher. Sept. 2002 – Dec. 2002. College Station, TX.

- Production of searchable bibliography of information on threatened and endangered species in the Rio Grande Basin.

La Universidad del Zulia (LUZ) Venezuela – Shell de Venezuela. Researcher and Biodiversity Sub-projects Coordinator. Jan. 2000 – Dec. 2002.

- Research on aquatic bird diversity and bird–fish interactions, and research assistant on fish, crustacean and aquatic mammal diversity.

La Universidad del Zulia (LUZ) Venezuela. Graduate Research and Teaching Assistant. Oct. 1998 – Dec. 2001.

- Research on bird diversity, foraging ecology and modeling of Cormorant harvests and wetland interactions. Teaching assistant, Lab of Population Biology. Coordinator of field trips, science and public relations communicator, and technical report editor.

La Universidad del Zulia (LUZ) – Consejo de Desarrollo Cientifico (CONDES). Biologist. Aug. 1996 – Dec. 1997.

- Comparative study of bird diversity in an evergreen forest and a savanna in "Las Porqueras" sector, Dinira National Park, Lara State, Venezuela.

Producciones RODENEZA. Regional Manager, Supervisor and Sales representative. Jul. 1994 - Oct. 1997. Zulia State, Venezuela.

Consejo Nacional de Investigaciones Cientificas y Tecnologicas (CONICIT). Biologist, Research Assistant. Apr. 1984 – Apr. 1985**.**

- Analysis of the diet of rodents at the plains in Guarico State.

TEACHING EXPERIENCE

- Biology II (Bio 112): Evolution, biological diversity, ecology and comparative structure and function of organisms. Texas A&M University. Department of Biology. Spring 2014 to 2016.
- Biology for non-majors (Bio113) (General Biology I and II): Cell biology, evolution, genetics, plant and animal biology and physiology. Texas A&M University. Department of Biology. Fall 2014, 2015.
- Biology I (Bio 111) Lab Instructor: The chemical basis of life, structure and function of cells, energy transformations, and molecular biology and genetics. Texas A&M University. Department of Biology. Fall 2013.
- Biology II (Bio 1407): Evolution, biological diversity, ecology and comparative structure and function of organisms. Blinn College, Bryan, Texas. Summer I and II, 2012.
- General Biology I (Bio 1406): The chemical basis of life, structure and function of cells, energy transformations, and molecular biology and genetics; Biology II: Evolution, biological diversity, ecology and comparative structure and function of organisms. Blinn College, Bryan, Texas. Spring 2012.
- General Biology I - Graduate level course (Bio 1406). Blinn College, Bryan, Texas. Fall 2011 (2 sections).
- Ecology, Management and System Analysis for Natural Resources Sustainability. Universidad de Juárez, Estado de Durango, Mexico. October, 2006.
- Tropical Coastal Ecosystems Course: Biology, Ecology and Environmental Management - Mangrove and Lake Maracaibo Ecosystems. Universidad de Las Palmas. Canary Island. March 2001 (40 hours). Undergraduate and graduate students.
- Preparation and Evaluation of Environmental Studies. Universidad del Zulia, College of Economics. U.C.P.C., Maracaibo, Venezuela. December, 2000.
- Ecological Guidelines for Environmental Problems. Universidad del Zulia, Faculty of Agronomy, Maracaibo, Venezuela. October, 2000.
- Ecology and Natural Resources Management. System Analysis and Simulation (Teacher assistant: workshop). Productora del Sal. Co., Maracaibo, Venezuela. May, 2000.
- Population Biology Lab Teaching assistant. Faculty of Sciences. La Universidad del Zulia. Maracaibo, Venezuela. 1998 – 2002**.**

ADDITIONAL TRAINING AND EXPERIENCE

- Teacher Preparation and Certification Program–Life Science 7-12; 117 credit hours approved from Jan-August 2013, at ESC Region 6, Huntsville, TX.

- Workshop to support the use of the conservation design approach to map coastal avian habitat in Central Texas, at University of Texas Marine Science Institute, Port Aransas, TX. June 7th, 2012. The International Crane Foundation and Gulf Coast Bird Observatory.
- Third Workshop, Whooping Crane Conservation Action Planning Meeting. Corpus Christi, TX. January 10, 2010.
- Second Workshop, Whooping Crane Conservation Action Planning Meeting. Saskatoon, Saskatchewan, Canada. October 5–10, 2009,
- Workshop on Data Archiving. American Ornithologists' Union Meeting, AOU 2009. University of Pennsylvania, Philadelphia. August 12, 2009.
- First Workshop, Whooping Crane Conservation Action Planning Meeting. Platte River Whooping Crane Trust, Wood River, NE. March 31-April 3, 2009.
- Workshop on Spatial Modeling of Stream Network Data. Ecological Society of America Meeting. San Jose, CA. August 2007.
- Studies on the Evaluation of Environmental Impacts. Zulia University, Maracaibo, Venezuela, October 2000.
- Management of Environmental Conflicts. Inter-American Center for Development and Environmental and Territorial Research, Merida, Venezuela. December, 1999.
- Professor and Co-chair directing five undergraduate theses for the five-year Bachelor of Science Degree in Biology. Zulia University, Maracaibo, Venezuela.

AWARDS, FELLOWSHIPS, GRANTS

- Historical Whooping Crane Sighting Database: Habitat Use and Temporal-Geographic Distribution Patterns in Nebraska. Grant from the Platte River Recovery Program, PRRIP. June 2011 – April 2012.
- Whooping Crane Telemetry Project. Co-Principal Investigator with F. Chavez-Ramirez, G. Krapu and J. Rempel. 2009 (USGS and PRRIP).
- Google Earth Pro Grant for Whooping Crane Project: Principal Investigator. Distribution of banded birds and use of stopover areas. 2008-2010.
- Richard Baldauf Memorial Scholarship, 2004. Dept. Wildlife Fisheries Sciences (WFSC), Texas A&M University.
- Good Neighbor Scholarship, International Scholarship, State of Texas, 2004 - 2005.
- Research and Presentation Grant, Office of Graduate Studies, Texas A&M University, 2004.
- Research Project: Spatial relations of aquatic bird species, irrigation systems, water reservoirs and natural areas in Rio Grande Bravo Basin. 2004 - 2005.
- Research Project: Rare, threatened and endangered species in Rio Grande/ Rio Bravo Basin (2003).
- Research Project: Biodiversity in Urdaneta West Field, Maracaibo Lake. Shell of Venezuela – LUZ. Contract No.UW/00953, 2002.
- Inter-Institutional Research Project: Biodiversity in Los Olivitos wetland and adjacent areas. LUZ - # 98003428. 1998 – 2002. (Co-principal Investigator with Dr. E. Weir, and C. Casler).

PUBLICATIONS

Books

Gil Karine. The Biology and Conservation of the Whooping Crane (Grus americana), in process. Lead author, Chapters on Population Dynamics, Dispersal Patterns and Lifetime reproductive success. Editors Dr. J. French, S. Converse and F. Chavez-Ramirez, Academic Press.

Enrique Weir and **Gil- Weir, Karine .** 2014. Música de las Grullas. Una historia natural de las grullas de America. Translation from English to Spanish of "Crane Music" by Paul Johnsgard. University of Nebraska-Lincoln. Zea Books. 179 pp**.**

Gil, K., C. Casler and E. H Weir 2003. Biodiversity in Maracaibo Lake. West Urdaneta Camp. Zulia University – SHELL de Venezuela. S.A 2003. Maracaibo, Venezuela. Ediciones Astro Data, S.A, 267 pp. ISBN 980-232-883-9. Two languages: English and Spanish.

Gil. K., and N. Wilkins. 2003. Rio Grande/Rio Bravo Basin Endangered and Threatened Species: A Bibliography. Texas A&M Publication. CD and on-line version. http://landinfo.tamu.edu/riogrande.

Peer-Reviewed Publications

Wilson, S., **K. Gil-Weir**, R. G. Clark, G.J. Robertson and M.T. Bidwell. 2016. Using Integrated Population Modeling to Assess Demographic Variation and Limiting Factors for Endangered Whooping Cranes. Biological Conservation, 197:1-7.

Gil-Weir, K. C; W.E. Grant; R. D. Slack, H-H. Wang, and M. Fujiwara. 2012. Demography and population trends of Whooping Cranes. Journal of Field Ornithology 83: 1-10.

Gil de Weir, K., E. H. Weir, C. Casler, and S. Aniyar. 2011. Ecological Functions and Economic Value of the Neotropic Cormorant (*Phalacrocorax brasilianus*) in Los Olivitos Estuary, Venezuela. Environment and Development Economics 16: 553 -572.

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Weir E., W. Contreras, and **K. Gil-Weir**. 2007. Biological control of *Diatrea* spp. (Lepidoptera: Pyralidae) in sugarcane crops in Central Venezuela. *Rev. Biol. Trop*. 55: 655 – 658.

Paredes, M., E. Weir, and **K. Gil**. 2001. Reproducción del ave *Mimus gilvus* (Passeriformes: Mimidae) en Maracaibo, Venezuela. *Revista de Biología Tropical* 49(3): 1143-1146.

Weir, E. H. and **K. Gil.** 1999. Competencia interespecífica entre *Penicillium citrinum* y *Fusarium oxysporum* (Interspecific competition between *Penicillium citrinum and Fusarium oxysporum*). *Boletín del Centro de Investigaciones Biológicas* 33(2): 83 - 92.

Vivas, A., R. Roca, E.H. Weir, **K. Gil** and P. Gutiérrez. 1986. Ritmo de Actividad Nocturna de *Zygodontomys microtinus, Sigmodon alstoni* y *Marmosa robinsoni* en Masaguaral, Estado Guárico. (Rhythm of Nocturnal Activity of *Zygodontomys microtinus, Sigmodon alstoni* and *Marmosa robinsoni* in Masaguaral, Guárico State). *Acta Científica Venezolana* 37: 456 - 458.

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Gil-Weir, K, and F. Chavez-Ramirez. Temporal-Spatial Distribution and Abundance of Roosting Sandhill Cranes in the Central Platte River Valley, Nebraska, USA". Waterbirds. (Accepted pending minor revisions) (CW14-0911).

Weir, E. H**., K. Gil-Weir**, and C. Casler. Avifauna of Dinira National Park, Las Porqueras Mountains, western Venezuela. *Boletín del Centro de Investigaciones Biológicas* (Accepted, pending minor revisions).

Weir, E. H., W.E. Grant, N. Wilkins and **K.Gil-Weir.** Spatial relations of aquatic bird species, irrigation system, water reservoirs and natural areas in the Lower Río Grande Basin. (To be re-submitted to *Texas Journal of Sciences*).

Gil-Weir, K., F. Chavez-Ramirez and W.E. Grant. An energetic budget model of wintering Whooping Cranes (To be submitted to *The Auk*).

Gil-Weir, K., F. Chavez-Ramirez, B. Johns, L. Craig-Moore, T. Stehn and R. Silva. Whooping Crane family pattern distribution at the breeding and wintering grounds and stopover use during migration (To be submitted to *Avian Biology*).

Gil-Weir, K.. Impacts of global and regional climate, trends and events, on population dynamics of an endangered species (To be submitted to *Biological Conservation*).

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Weir. E. H., and **K. Gil**. 2016. Historical whooping crane sighting database: habitat use and temporal – geographic distribution patterns on the Central Flyway (an update to 2015). Ecosystems Advisors LP, College Station - Texas.

K. Gil -Weir, and E. H. Weir. 2014. Historical Whooping Crane sighting database: habitat use and temporal – geographic distribution patterns on the Central Flyway (an update to 2011). Ecosystems Advisors LP, College Station - Texas.

Gil-Weir, K. and E. Weir. EALP. 2011**.** Historical Whooping Crane Sighting Database: Habitat Use and Temporal-Geographic Distribution Patterns in Nebraska. Final Report for the Platte River Recovery Program, Nov. 2011.

Weir, E. H., A. Urbina**, K. Gil**, C. Casler, R. Buonocore, G. Andrade, D. Romero, L. García-Pinto, C. Sangronis. 2006. Biodiversidad en el ecosistema manglar Los Olivitos y areas adyacentes / Biodiversity in Los Olivitos mangrove and neighboring areas. Informe final /

Final report. FONACIT (Fondo Nacional de Investigaciones Científicas y Tecnológicas). Caracas, Venezuela. 1000 pp.

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Scientific publications (non-peer review)

P. Johnsgard and **K. Gil.** Sandhill Cranes: Our Avian Ambassadors At-Large. Prairie Fire Publications, February 2011.

K. Gil and P. Johnsgard. The Whooping Cranes, Survivors against all odds. Prairie Fire Publications, September 2010.

CONGRESSES, SYMPOSIUMS AND WORKSHOPS

Gil-Weir, K. and **E. Weir**. Proposal of an integrated database for the wild Whooping Crane population. Presented to the board of the Whooping Crane Recovery Program, in the Thirteen North American Crane Workshop. Lafayette, Louisiana. 2014.

Gil-Weir, K., F. Chavez-Ramirez, B. Johns, L. Craig-Moore, T. Stehn, and R. Silva. Historical breeding, stopover and wintering distributions of a Whooping Crane family. Joint Meeting of 11th North American Crane Workshop and 34th Annual Meeting of the Waterbird Society. 13-16 March, 2011. Grand Island, NE.

Gil-Weir, K., W. E. Grant, R. D. Slack, and H. Wang. Demography and predicted population trends of the Whooping Crane**.** Association of Field Ornithologists, Cooper Ornithological Society, and Wilson Ornithological Society FO/COS/WOS, 9 – 13 March 2011. Kearney, NE.

Gil-Weir, K., W. Grant, R. D. Slack. and E. Weir. Impacts of global and regional climate on Whooping Crane demography: trends and extreme events. 2nd. Conference “Bird Migration

and Global Change," MIGRES. Movement Ecology and Conservation Strategies. Strait of Gibraltar, Algeciras SW Spain, March 17-20, 2010.

Gil, K., and F. Chavez-Ramirez. Temporal - Spatial distribution and abundance of roosting Sandhill Cranes in the Central Platte River: 2002-2009, Nebraska, USA.33rd Annual Meeting - Waterbird Society. Cape May, NJ. Nov 2009.

Gil de Weir, K., E. Weir, C. Casler, and S. Aniyar. Ecological functions and economic value of the Neotropic Cormorant (*Phalacrocorax brasilianus*) in Los Olivitos Estuary, Venezuela. 33rd Annual Meeting - Waterbird Society. Cape May, NJ. Nov 2009.

Gil, K., and F. Chavez-Ramirez. Temporal - Spatial distribution and abundance of roosting Sandhill Cranes in the Central Platte River: Platte River Symposium. Kearney, Nebraska. October 13, 2009.

Gil, K., F. Chavez-Ramirez and W. Grant. Wintering Whooping Cranes: An energetics budget model. Ecological Society of America. Albuquerque, New Mexico. August 2-7, 2009.

Gil, K., and F. Chavez-Ramirez. Individual Whooping Crane's family history: Patterns of distribution and stopover use. American Ornithologist's Union. Philadelphia, Pennsylvania. August 12-15, 2009.

Gil, K. A 30-year history of Whooping Crane family, offspring, and behavior. Rivers and Wildlife Celebration. Audubon Nebraska, Audubon's Rowe Sanctuary, and the Nebraska Partnership for All-Bird Conservation. Kearney, Nebraska. March 20-22, 2009.

Gil, K. Historical use of wetlands by banded Whooping Cranes. The 14th Annual Rainwater Basin Joint Venture Informational Seminar. Hastings, Nebraska. February 10, 2009.

Gil, K. Impacts of global and regional climate on Whooping Crane demography: Trends and extreme events. The 11th North American Crane Working Group. Wisconsin. September 23 – 27, 2008.

Gil, K., F. Chavez- Ramirez, B. Johns, T. Stehn and R. Silva. An individual Whooping Crane's family history. The 11th North American Crane Working Group. Wisconsin Dells, Wisconsin. September 23 – 27, 2008.

Gil, K., W. Grant, D. R. Slack and E. Weir. Impacts of global and regional climate on population dynamics of an endangered migratory bird. Ecological Society of America Meeting. Milwaukee, Wisconsin. August 3-8, 2008.

Gil, K., and F. Chavez-Ramirez. Let's migrate as Whooping Cranes**.** Ecological Society of America Meeting. Milwaukee, Wisconsin. August 3-8, 2008.

Gil-Weir, K. Effects of environmental factors on Whooping Crane demography: A modeling study. The 38th Annual Rivers and Wildlife Celebration, Kearney, Nebraska. March 14-16,

2008.

Gil, K. Whooping Crane wild population modeling: demography and effects of environmental factors. The Wildlife Society Nebraska Chapter & Society of Range Management Annual Meeting. Grand Island, Nebraska. October 10-12, 2007.

Gil -Weir, K. Aransas–Wood Buffalo population modeling study. Whooping Crane Recovery Team Meeting. Lafayette, Louisiana. February 1st, 2007.

Gil -Weir, K., W. Grant and D. R. Slack. Life history and demography of the Whooping Crane: A new life table. 91st Annual Meeting of the Ecological Society of America. Memphis, Tennessee. August 2006.

Weir, E., N. Wilkins and **K. Gil de Weir.** Spatial relations of aquatic bird species, irrigation systems, water reservoirs and natural areas in the lower Rio Grande Basin. Fourth Annual Rio Grande Basin Initiatives Conference. Sul Ross State University, Alpine, Texas. April 12-14, 2005.

Weir, E., N. Wilkins and **K. Gil de Weir.** Spatial relations of aquatic bird species, irrigation systems, water reservoirs and natural areas in the lower Rio Grande Basin. (Second Year report 2004-05). Fourth Annual Rio Grande Basin Initiatives Conference. Sul Ross State University, Alpine, Texas. April 12-14, 2005.

Gil de Weir, K., E. Weir, C. Casler and S. Aniyar. Ecological functions and economic value of Neotropic Cormorants in Los Olivitos estuary. 6th Annual Bioecon Conference on "Economics and the Analysis of Biology and Biodiversity". Kings College Cambridge University of Cambridge, England. September 2-3, 2004.

Gil, K. and W. Grant. Whooping crane demographic and energetic submodels. Second Workshop of Modeling San Antonio Guadalupe Estuarine System. San Antonio, Texas. September 28–30, 2004.

Weir, E.H., N. Wilkins, and **K. Gil-Weir.** Spatial relations of aquatic bird species, irrigation systems, water reservoirs and natural areas in the Lower Rio Grande Basin. Rio Grande Basin Initiative Annual Conference. Las Cruces, New Mexico. April 2004.

Gil de Weir, K. and N. Wilkins. Rare, endangered and threatened species in Rio Grande/Rio Bravo Basin. Student Research Symposium in Conservation, Ecology, and Evolutionary Biology. Texas A&M University, College Station, Texas. February 21, 2004.

Gil-Weir, K. and E. H. Weir. Estimating the economic value of Neotropic Cormorant (*Phalacrocorax brasilianus*) in Los Olivitos estuary, Venezuela. Beijer Research Seminar on Environmental Economics. Eco Paraiso Hotel, Merida, Mexico. December 2001.

Gil -Weir, K. and E. H. Weir. Fish and shrimp consumption by the Olivaceus Cormorant population in Los Olivitos estuary, Venezuela. International Symposium and Workshop on

Interaction between Fish and Birds: Implications for Management. University of Hull, England. April 2001.

Gil de Weir, K. A comparative diet methods of Olivaceus Cormorant: Stomach contents and pellets analysis. IV Venezuelan Congress of Ecology, Merida, Venezuela. October 29 – November 2nd, 2001.

Weir, E., **K. Gil -Weir** and C. Casler. Bird richness and abundance in the Los Olivitos Wildlife Refuge and Fisheries Reserve. Zulia State. IV Venezuelan Congress of Ecology, Merida, Venezuela. October – November 2001.

Ramirez, S., E. Weir and **K. Gil -Weir.** Composition and diversity of the birds in a dry forest adjacent to the Los Olivitos's swamp. IV Venezuelan Congress of Ecology, Merida, Venezuela. October – November 2001.

Weir, E., **K. Gil -Weir** and C .Casler. A comparative bird diversity study at Ancon de Iturre-Quisiro dry forest, Zulia State, Venezuela. 86th Annual Meeting of the Ecological Society of America. Madison, Wisconsin. August 5-10, 2001.

Gil -Weir, K. and C. Casler. Abundance and diet of the Olivaceus Cormorant (*Phalacrocorax brasilianus*) in the Los Olivitos Estuary, Zulia State, Venezuela. Joint Ecology Meeting BES/ESA (British Ecological Society / Ecological Society of America) Orlando, Florida. April 10-13, 2000.

Weir, E., **K. Gil -Weir**, S. Ramirez and A. Saras. A comparative study of the diversity of birds in two tropical deciduous forest in Dinira National Park and neighboring areas of the Los Olivitos mangrove. Venezuela. Joint Ecology Meeting BES/ESA. Orlando, Florida. April 10-13, 2000.

Weir, E., and **K. Gil-Weir**. A comparative study of the diversity of birds in an evergreen forest and a grassy plain, Dinira National Park, Venezuela. Annual Meeting Ecological Society of America. Spokane, Washington. August 8-12, 1999.

Weir. E., W. Contreras, and **K**. **Gil-Weir.** Biological control of *Diatraea sp.* (Lepidoptera: Pyralidae) in sugarcane crops in Aragua and Carabobo States. Venezuela. VII International Congress of Ecology. INTECOL. Florence, Italy. July 19-25, 1998.

Weir, E. and **K. Gil-Weir**. Competition between *Penicilum citrinum* and *Fusarium oxisporum*. III Congreso Latinoamericano de Ecología. Merida, Venezuela. October 22-28, 1995.

CONFERENCES

Gil-Weir, Karine. Cranes, Biology and Inspiration, Sandhill Cranes and Whooping Cranes. Guest speaker for the Travis Audubon Society, Austin, February 18, 2016.

Gil-Weir, Karine. Cranes, Biology and Inspiration, Sandhill Cranes and Whooping Cranes. Guest speaker for the Lost pines Christmas Bird Count, Bastrop County Audubon Society, LCRA's McKinney Roughs Nature Park, Lost Pines Chapter - Texas Master Naturalist

Program, at Hyatt Regency Lost Pines Resort & Spa, December 20, 2015.

Gil-Weir, Karine. Cranes, Biology and Inspiration, Sandhill Cranes and Whooping Cranes. Guest speaker for the Rio Brazos Audubon Society, April 8th, 2015, at the Brazos Valley Museum of Natural History, Bryan, TX.

Gil, K. Whooping Crane and Sandhill Crane Research. "Wings Speaker Series", at Stuhr Museum. March 5th, 2011.

Gil, K. Spatial Distribution/Abundance of Roosting Cranes in Platte River Valley". The 41st Annual Rivers and Wildlife Celebration. March 19th, 2011.

Gil, K. Whooping Crane and Sandhill Crane Migration, and use of the Platte River in Nebraska. Nebraska Nature and Visitors Center Speaker Series, March 20th, 2010.

Gil, K. Cranes Migration, and Inspiration. Grand Island Public Library, NE. For the Nebraska Library Association/Nebraska Educational Media Association 2010 Conference. October 13th, 2010**.**

Gil, K. Impacts of global and regional climate on Whooping Crane demography: trends and extreme events. Hastings College, Department of Biology. March 24th, 2010.

Gil, K. Whooping Crane life cycle and population dynamic during the last 30 years. Stuhr Museum. Grand Island, Nebraska. March 2 and March 27, 2009.

Gil, K. Whooping Crane and Sandhill Crane: migration and inspiration. At the Monshell Art Awards. Riverside Club, Grand Island, NE. February 19, 2009

Gil, K. Whooping Crane life cycle and population dynamics during the last 30 years. Sturh Museum, Grand Island, Nebraska. March 1st and March 28th, 2008.

Gil, K. Whooping Crane life cycle and population dynamics during the last 30 years. Kiwanis International. Howard Johnson Hotel, Grand Island, NE. March 7, 2008.

Gil, K. Ecology of the Whooping Crane. Crane Meadows Center. Wood River, Nebraska. March 4th and April 1st., 2007.

Gil, K. Demography of the Whooping Crane and environmental factors in a simulation model / Demografía de la grulla americana y los factores ambientales en un modelo de simulación. Aula Laureano Roncal de la Universidad Juárez del Estado de Durango, Mexico. Oct 25, 2006 (in Spanish).

OUTREACH EXPERIENCE

- Coordinator of the Whooper Watch Program at the Whooping Crane Trust. Nebraska, Spring and Fall Migrations: 2007, 2008, 2009, 2010 and Spring 2011.
- Nebraska Outdoor Exhibition, Game and Parks. Whooping Crane Migration Game and Presentation for approximately 500 children. March 2008.
- Environmental education conference and children interactive activity "The Life cycle of the Whooping Crane" at the Crane Meadows Center (Wood River) and at the Hastings Children Museum, February and March 2007.
- Coordinator of two workshops for ecosystem modelers for San Antonio Guadalupe Estuarine System, SAGES project, 2003, and 2005. Texas A&M University.

- Production of two videos of the Biodiversity in Maracaibo Lake for Zulia University and Shell of Venezuela, December 2003.

SCIENTIFIC AND PROFESSIONAL ORGANIZATION MEMBERSHIPS

- American Ornithologists' Union (2009- present)
- Waterbird Society (2009- present)
- Ecological Society of America member (ESA-2000-present)
- International Society of Ecological Modeling (ISEM- 1998- present)
- Sociedad Venezolana de Ecología (SVE- 2002 - present)
- Wetland International Cormorant Research Group (WICRG- 2001- present)
- Asociación de Egresados en Ciencias del Edo. Zulia (1992-2002)
- North American Crane Working Group (2008- present)
- Whooping Crane Conservation Association (2008- present)

SKILLS

- Blackboard Learning Management System, Angel version teaching experience.
- Biology Lab and field equipment / field trip coordination experience.
- Trapping (mammals, birds, fish and insects), monitoring, ground and aerial bird census.
- Microsoft Office (Word, Excel, Power Point, Publisher, and Access), End Note, Google Earth Pro, Argos.
- Spatial programs: GIS ArcView, V. 9.2.
- Modeling software: STELLA model simulation, RAMAS METAPOP.
- Statistics packages: STATA, and SPSS.
- Languages: Spanish (native), English (fluent), and Swedish (basic).

ENRIQUE H. WEIR
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henryweir@ecosystemsadvisors.com

EDUCATION

Texas A&M University, College Station, TX 2002-2005

- Postdoc in Ecology and management of natural resources, systems analyses and simulations

Universidad Simón Bolívar, Venezuela 1991

- Ph.D. in Ecosystem Science Ecology

Universidad Simón Bolívar, Venezuela 1982

- M.S and B.S in Biology

RELEVANT EXPERIENCE

Ecosystems Advisors LP, Texas 03/2011- Present
Senior Environmental Scientist

- Analyzing, monitoring and mitigating the impacts of land and habitat degradation with a focus on species protection.
- Research projects include:
    - Historic whooping crane sighting database: habitat use and temporal- geographic distribution patterns in the Central Flyway.
    - Effect of the PDO, El Niño, and Temperature global change in aquatic birds assemblages.
- Coordinator and instructor of workshops in systems analysis and simulations, use of GIS and spatial models to analyze effects of climate change in aquatic bird populations.
- Environmental audits and inspections of the critical habitats of whooping cranes in Nebraska and the Central flyway.

Crane Trust and Ecosystem Advisors LP, Nebraska**,** 07/2007-03/2011
Systems Ecologist

- Developed an ecological model for the relationship between habitat availability and the distribution of migratory aquatic birds, to assess habitat management and the impacts of climate change.
- Created a bibliography database of the wet meadow habitat associated with the Platte River System, in order to develop a comprehensive "wet meadow's work definition," for the Platte River Recovery Implementation Program.
- Conducted environmental audits and inspections of the whooping crane critical habitat in Nebraska and the Central flyway.

- Monitored the effects of crane habitat degradation and recommended means of prevention and/or mitigation.

The Beijer International Institute of Environmental Economics, Royal Swedish Academy of Sciences, Stockholm, Sweden.11/2005 – 10/2006
Guest Researcher

- Developed a conceptual model and inter-institutional and inter-disciplinary proposal for the Decision Support System for the Great Cormorant-Fisheries Conflict in Sweden.

Texas A&M University, College Station, Texas 09/2002 – 10/2005
Environmental Specialist

- Developed a spatial model of the relationship between water availability, climate conditions and aquatic bird distribution and abundance in the Lower Rio Grande Valley of Texas.

Universidad del Zulia, Universidad Rafael Maria Baralt, INIA, MARN, Maracaibo, Venezuela.
Chief Researcher and General Coordinator 01/1998 - 12/2004

- Research Programs:
    - Biodiversity of the West Urdaneta Field, Lake Maracaibo, Venezuela
      (Funding by Shell Venezuela S.A.)
    - Biodiversity of Los Olivitos Ecosystem and Adjacent Areas, West Venezuela.
    - FONICIT and The Interamerican Development Bank

Universidad del Zulia, Ministry of Environment, Zulia Government, Maracaibo, Venezuela. 1999. *Group Member*

- Advisor on the environmental impacts of the Aguas Profundas Port of Lago de Maracaibo

Petroquímica de Venezuela S.A. El Tablazo, Venezuela , 11/1991 - 09/1995. *Water and Soil Remediation Supervisor*

- Supervisor of the sanitary and remediation field for the Petrochemical Complex
- Developed the protocol for the toxicological analysis of the final effluent of the Petrochemical Complex
- Taught the extension course: “Environmental protection and petrochemical and oil activities”
- Developed environmental inspection protocols for the oil and petrochemical companies in Lake Maracaibo
- Member of Environmental Committee of “Petroleos of Venezuela.”

ACADEMIC APPOINTMENTS

Innova College, Miami, Florida 06/2013- Current
Professor of Biology

Lone Star College- Cyfair, Cypress, TX 07/2014-12/2014
Adjunct Professor of Environmental Science

Universidad de Juarez, Durango, Mexico. 2006-2013
Visiting Professor

- Simulation Models Course on Ecosystems and Populations

Texas A&M University, College Station, TX 01/2003-10/2005
Visiting Professor

- Postdoctoral research: "Spatial relations of aquatic bird species, irrigation system, water reservoirs and natural areas in the Lower Rio Grande Basin."

Universidad del Zulia, Maracaibo, Venezuela 01/1995-12/2004
Professor of Ecology

- Courses: Ecology, Population Ecology, Animal Ecology and Natural Resources Management.
- Administrator of the Graduate Programs of Biology and Applied Ecology.

SKILL SUMMARY

- Environmental audits and environmental impact assessments
- Economic analysis of natural resources
- Animal inventories in estuaries, wetlands, river basins, dry forest, great plains, savannas, and agro-ecosystems
- Evaluation of climate change impacts on wildlife and fisheries and their habitats
- Development and application of spatial and analytical models to natural resources impacts, conservation and management
- Ecology and epidemiology of disease originated by insect vectors

Publications:

Johnsgard, Paul A., **Weir, Enrique H**. and Gil-Weir, Karine. "Música de las grullas: una historia natural de las grullas de América" (2014). *Zea E-Books.* Book 25. http://digitalcommons.unl.edu/zeabook/25

Gil-Weir, K., **E.H. Weir**, C. L. Casler, and S. Aniyar. 2011. Ecological Functions and Economic Value of the Neotropic Cormorant (*Phalacrocorax brasilianus*) in Los Olivitos Estuary, Venezuela. Environment and Development Economics. 16(5): 553-572

Weir, E.H., K. Gil-Weir, and C.L. Casler. 2010. Riqueza y abundancia de la aves en el Refugio de Fauna y Reserva de Pesca Ciénaga Los Olivitos, Estado Zulia. Boletín del Centro de Investigaciones Biológicas 44(4): 403-424.

Garcia, M. Ch., C., L. Casler, N. Méndez y **E.H. Weir**. 2008. Avifauna del bosque de manglar del Refugio de Fauna Silvestre Ciénaga Los Olivitos **E.H. Weir,** and C. Casler. 2004. Biodiversity of West Urdaneta Field, Lake Maracaibo, Venezuela. Universidad del Zulia-SHELL de Venezuela. Editorial Astrodata, Maracaibo, Venezuela. 267 pp.

Paredes, M., **E. H. Weir,** and K. Gil. 2001. Reproducción del ave *Mimus gilvus* (Passeriformes: Mimidae) en Maracaibo, Venezuela. Revista de Biología Tropical 49(3):1143-1146.

Chávez, R., J. Delgado, M. Paredes, and **E. H. Weir**. 2000. Primer Registro de *Lironeca tenuistylis* (Richardson, 1912) (Isopoda: Cymothoidae) para Venezuela. Boletín del Centro de Investigaciones Biológicas. 34 (3): 423-428

Weir, E.H., and K. Gil. 1999. Competencia interespecífica entre Penicillium *citrinum* y *Fusarium oxysporum*. Boletín del Centro de Investigaciones Biológicas. 33 (2): 83-92.

Weir, E.H., and L.Sagarzazu. 1998. Interspecific competition between *Metagonystilum minense* (Diptera: Tachinidae) and *Cotesia flavipes* (Hymenoptera: Brachonidae) parasitoids of sugarcane borers *Diatraea* sp. (Lepidoptera: Pyralidae). Revista de Biología Tropical 46(4): 1133-37

Weir, E.H., and A. Vivas. 1997. Preferencia de *Metagonystilum minense* (Diptera: Tachinidae) entre *Diatraea saccharalis* y *Diatraea rosa* (Lepidoptera: Pyralidae). Boletín del Centro de Investigaciones Biológicas. 31 (2): 111-121

Weir, E.H., M. Muñoz, and A. Vivas. 1996. Madurez Testicular en *Holochilus venezuelae* y *Sigmodon alstoni*. Boletín del Centro de Investigaciones Biológicas. 30(2): 187-194.

Weir, E.H., and Benado, M. 1996. Estudio del Comportamiento de Oviposición en *Drosophila martensis* en sustratos fermentados de cactos Ciencia. 4 (Suplemento Especial): 33-38.

Mäler, K-G., S. Aniyar, C. Casler, **E. H. Weir**, J. Fuenmayor, J. Rojas, and J. Reyes. 1996. An Economic Model of the Los Olivitos

Weir, E.H. 1991. Competencia intraespecifica y respuestas comportamentales en *Metagonystilum minense*. Tesis Doctoral (Intra-specific, Venezuela. Boletín del Centro de Investigaciones Biológicas 42(4): 521-549.

Weir, E.H., W. Contreras, and Gil-Weir, K. 2007. Biological control of *Diatraea* spp. (Lepidoptera: Pyralidae) in sugarcane crops in Central Venezuela. Rev.Biol.Trop. (Int.J.Trop.Ecol) 55(2):655-658.

<u>Congress and symposia presentations</u>:

Gil, K. and **E.H. Weir**. Proposal of an integrated database for the wild Whooping Crane population. Presented to the board of the Whooping Crane Recovery Program, in the Thirteen North American Crane Workshop. Lafayette, Louisiana. 2014

Weir, E.H. Efecto del cambio climático en la expansión o regresión en el rango geográfico de las especies. 2do. Congreso Multidisciplinario de Ciencias Aplicadas en Latinoamérica.

Ciudad de Guatemala, Guatemala, 2014.

Weir, E.H. 5to Congreso de Ingenieria Tecnologica. "Dinámica de la biodiversidad en ecosistemas de humedales en zonas tropicales y templadas, implicaciones para el manejo y conservación". Durango. Mexico. 2013.

Weir, E.H., and F. Chavez-Ramirez. Wet meadows distribution, use by whooping cranes and other migratory birds, and hydrological influence at South Central Nebraska: a literature and information summary and evaluation. 2011.

Gil de Weir, K, **Weir, E.H.**, C.Casler, and S. Aniyar. Ecological Functions and Economic Value of the Neotropic Cormorant in los Olivitos Estuary, Venezuela. 33rd Annual Meeting-Waterbird Society. Cape May, New Jersey. November 2009.

Weir, E.H. Birds species richness and abundance associated with water availability, and climate in south-Central Nebraska. 33rd Annual Meeting-Waterbird Society. Cape May, New Jersey. November 2009.

Weir, E.H. Bird Species Richness and Abundance Associated with Water Availability, Habitat Management and Climate in South-Central Nebraska. Fall Platte River Basin Science and Resource Management Symposium. Kearney, Nebraska. October, 2009. http://watercenter.unl.edu/PRS/PRS2009/PRS2009.asp

Weir, E.H. Bird species richness and abundance associated with water availability, and climate in south-central Nebraska. 94th Annual Meeting of the Ecological Society of America. Albuquerque Milwaukee, New Mexico. August 2009.

Weir, E.H. and F. Chavez-Ramirez. A simulation model for the relationship among water flow, groundwater, wet meadows, and aquatic birds at central Platte River, Nebraska. 93th Annual Meeting of the Ecological Society of America.Milwaukee, Wisconsin. August 2008.

Gil, K., W.E. Grant, R.D.Slack, and **E.H. Weir**. Impacts of global and regional climate on population dynamics of the endangered whooping crane. 93th Annual Meeting of the Ecological Society of America.Milwaukee, Wisconsin. August 2008.

Weir, E.H. Spatial relations of aquatic bird species and water management in the Lower Rio Grande Basin. 91st Annual Meeting of the Ecological Society of America. Memphis, Tennessee. August, 2006. http://abstracts.co.allenpress.com/pweb/esa2006/document/?ID=61221

Weir, E.H., N. Wilkins and K. Gil. 2005. Spatial relations of aquatic bird species, irrigation system, water reservoirs and natural areas in the Lower Rio Grande Basin. Río Grande Basin Initiative Annual Conference. Alpine Texas. USA. April 2005. http://riogrande-conference.tamu.edu/wrapup2005presentations/session_5B/Task6_Weir.pdf

Gil, K., **E.H. Weir**, C. Casler, and S. Aniyar. Ecological Functions and Economic Value of the Neotropic Cormorant (*Phalacrocorax brasilianus*) in Los Olivitos Estuary, Venezuela. Cambridge. U.K. 6th Annual Bioecon. Conference on "Economics and Analysis of Biology and Biodiversity". Kings College Cambridge, University of Cambridge, England. September, 2004. http://www.ucl.ac.uk/bioecon/6th_paper/Gil%20De%20Weir.doc

Weir, E.H., N. Wilkins, and W.E. Grant. Spatial relations of aquatic birds, water availability and refuges in the lower Rio Grande valley. 89th. ESA Annual Meeting. Portland, Oregon. August, 2004. http://abstracts.co.allenpress.com/pweb/esa2004/document/?ID=38182

Weir, E.H., N. Wilkins, and Gil-Weir Karine. Spatial relations of aquatic bird species, irrigation system, water reservoirs and natural areas in the Lower Rio Grande basin. Río Grande Basin Initiative Annual Conference. Las Cruces New México. USA. April, 2004.

Weir, E.H., K. Gil-Weir, and C. Casler. Bird richness and abundance at The Olivitos Wildlife Refuge and Fishing Reserve, Zulia State, Venezuela. 88th. ESA Annual Meeting. Savannah, Georgia. August, 2003. http://abstracts.co.allenpress.com/pweb/esa2003/document/?ID=24995

Weir, E.H., K. Gil-Weir, C. Rodríguez. Rosales, R. Rivera, M. Chocron, and J. Velazco. Diet of nine fish species in the Los Olivitos estuarine, Zulia State, Venezuela. 87th. ESA Annual Meeting. Tucson, Arizona. USA. August, 2002. http://abstracts.co.allenpress.com/pweb/esa2002/document/?ID=4942

Gil-Weir, K., and **E.H. Weir.** Estimating the Economic value of the Neotropical Cormorant (*Phalacrocorax brasilianus*) in Los Olivitos estuary, Venezuela. 87th. ESA Annual Meeting. Tucson, Arizona. USA. August, 2002. http://abstracts.co.allenpress.com/pweb/esa2002/document/?ID=4942

Gil, K., **E.H. Weir,** and C. Casler. 2004. Biodiversity of West Urdaneta Field, Lake Maracaibo, Venezuela. Universidad del Zulia-SHELL de Venezuela. Editorial Astrodata, Maracaibo, Venezuela. 267 pp.

Weir, E.H., K. Gil de Weir, and C. L. Casler. A comparative bird study at Ancon de Iturre-Quisiro Dry Forest, Estado Zulia, Venezuela. .86th Annual Meeting Ecological Society of America (ESA), Madison, Wisconsin, U.S.A. August, 2001. http://abstracts.co.allenpress.com/pweb/esa2001/document/?ID=26157

Gil-Weir, K., and **E.H. Weir.** Fish and shrimp biomass consumption by the olivaceous cormorant population in Los Olivitos estuary, Venezuela. International Symposium and Workshop on Interaction between fish and birds, implications for management. Hull, England, April, 2001.

Weir, E. H., K. Gil-Weir, S. Ramirez, and A. Saras. A comparative study of the diversity of birds in two tropical deciduous forests, in Dinira National Park and Neighboring of the Los Olivitos Mangrove, Venezuela. British Ecological Society and Ecological Society of America. Orlando, Florida, U.S.A. April, 2000.

Weir, E. H., and K. Gil-Weir. A comparative study of the diversity of birds in an evergreen forest and a grassy plain, Dinira National Park, Lara State. Venezuela. 84th ESA Annual Meeting Ecological. Spokane, Washington. August, 1999.

Weir, E. H., and W. E. Grant. Mangrove and estuarine productivity: simulation of shrimp and fish Production as a function of litter fall and cormorant densities in Los Olivitos mangrove, Venezuela. Annual Meeting International Society for Ecological Modeling and 83rd ESA Annual Meeting. Baltimore, Maryland. August, 1998.

Weir, E. H., W.Contreras, and K. Gil de Weir. Biological Control of *Diatraea* sp. (Lepidoptera: Pyralidae) in sugarcane crops in Aragua and Carabobo States, Venezuela. VII

International Ecology Congress, International Association for Ecology (INTECOL), Florence, Italia. July, 1998.

Weir, E. H., and L. Sagarzazu. Interspecific Competition Between *Metagonystilum minense* and *Cotesia flavipes*, parasitoids of sugarcane borer. Annual Meeting American Society of Naturalists, Boulder, Colorado, U.S.A. June, 1997.

Weir, E. H., and M. Benado. Estudio del Comportamiento de Oviposición de Drosophila martensis en Sustratos Fermentados de Cactos. VII Jornadas de la Facultad de Ciencias, Universidad del Zulia, Maracaibo, Venezuela. July 1996.

Aniyar, S., C. Casler, and **E. H. Weir.** Economic Analysis of Mangrove Ecosystem in Zulia State, Venezuela. Case Study: Los Olivitos Wildlife Refuge and Fishing Reserve. Beijer Research Seminar, The Beijer Institute. Merida, Venezuela. January. 1996

Maler, K., S. Aniyar, C. Casler, and **E. H. Weir**. Coastal Wetlands and Global Warming - The Case of Los Olivitos. Symposium on the Environment and Sustainable Development. The Japan Development Bank Research Center on Global Warming. Hakonen, Japan. 1996

Weir, E. H., C. Casler, and S. Aniyar. Análisis Económico en Ecosistemas Manglarinos: Caso Refugio de Fauna y Reserva de Pesca Ciénaga Los Olivitos. III Congreso Latino Americano de Ecología, ULA. Mérida, Venezuela. October, 1995.

<u>Scientific reports</u>:

Weir. E.H., and K. Gil. 2016. Historical whooping crane sighting database: habitat use and temporal – geographic distribution patterns on the Central Flyway (an update to 2015). Ecosystems Advisors LP, College Station - Texas.

K. Gil -Weir, and **E.H. Weir**. 2014. Historical whooping crane sighting database: habitat use and temporal – geographic distribution patterns on the Central Flyway (an update to 2011). Ecosystems Advisors LP, College Station - Texas.

Weir, E.H., and K. Gil-Weir. 2013. Historical whooping crane sighting database: habitat use and temporal – geographic distribution patterns in Nebraska – User Manual. Platte River Recovery Implementation Programs, Kearney – Nebraska.

Gil-Weir, K. and **E. H. Weir**. 2012. Historical whooping crane sighting database: habitat use and temporal – geographic distribution patterns in Nebraska. Platte River Recovery Implementation Programs, Kearney – Nebraska.

Weir, E.H., and F. Chavez-Ramirez. 2011. Wet Meadow and Whooping Crane Information Review. Platte River Recovery Implementation Program. 54pp

Weir, E.H., A. Urbina, K. Gil, C. Casler, R. Buonocore, G. Andrade, D. Romero, L. García-Pinto, C. Sangronis *et al.* 2006. Biodiversidad en el Ecosistema Manglar Los Olivitos y Áreas Adyacentes. Informe Final. FONACIT (Fondo Nacional de Investigaciones Científicas y Tecnológicas). Caracas. Venezuela. 1000 pp.

Weir, E.H., N. Wilkins and K. Gil. 2005. Spatial relations of aquatic bird species, irrigation system, water reservoirs and natural areas in the Lower Rio Grande Basin. Texas A & M

University. Water Resource Institute. College Station, Texas USA.

Weir, E.H., C. Casler, K. Gil, A. Urbina, R. Parra, F. Ferrer, and J. Romero. 2004. Avian and Fisheries Diversity in West Urdaneta Field. Lake Maracaibo. Final Report. Shell Venezuela.

Weir, E.H., K. Gil, C.Casler, R. Buonocore, G. Andrade, D. Romero, L. García-Pinto, C. Sangronis *et al.* 2002. Biodiversity in Los Olivitos Ecosystem and adjacent zones, Report 2: Population and trophic dynamic in crustaceans, fish, birds and bats. FONACIT. Caracas. Venezuela. 333 pp.

Weir, E.H. 2002. Diversidad de Aves en el Monte Espinoso Tropical Adyacente al Ecosistema de Los Olivitos, Municipio Miranda, Estado Zulia. Trabajo de Ascenso presentado como requisito para ascender a la categoría de Profesor Titular. Universidad del Zulia. Maracaibo, Venezuela. 80 pp.

Weir, E.H., K. Gil, C.Casler, R. Buonocore, G. Andrade, D. Romero, L. García-Pinto, C. Sangronis *et al.* 2001. Biodiversity in Los Olivitos Ecosystem and adjacent zones, Report 1: Distribution, abundance, species composition, and diversity in plankton, benthos, commercial crabs and shrimps, fish, birds, mammals and reptiles communities. FONACIT. Caracas. Venezuela. 251 pp.

Workshops and Conferences:

Efecto del cambio climático global en la expansión o regresión del rango geográfico de las especies de aves. Facultad de Medicina Veterinaria y Zootecnia, Universidad de Juárez del Estado de Durango, Durango, México, 2017.

Efecto del cambio climático en la expansión o regresión en el rango geográfico de las especies. 2do. Congreso Multidisciplinario de Ciencias Aplicadas en Latinoamérica. Ciudad de Guatemala, Guatemala, 2014.

Dinámica de biodiversidad en ecosistemas de humedales y agro-ecosistemas en zonas tropicales y templadas, implicaciones para el manejo y conservación. 5 to Congreso de Ingeniería en Tecnología. Universidad Politécnica de Durango. 2013

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Evaluación y Análisis de Estudios de Impacto Ambiental. UCPC. Facultad de Ciencias Económicas y Sociales, Zulia University, Maracaibo, Venezuela, December 2000.

El Impacto de la contaminación del Lago de Maracaibo en la distribución y diversidad de organismos. Agronomy Faculty, Zulia University, Maracaibo. Venezuela. October 2000.

Ecology and sustainable development. Zulia University, Maracaibo, Venezuela. July 1998.

Applied Ecology. Jornadas del Programa de Investigación, VII Aniversario del Programa de Investigación de la UNERMB. May 1997. Cabimas, Venezuela.

Ecology and society. Zulia University, Maracaibo, Venezuela. July 1996.

Análisis Ecológico y Económico de Ecosistemas Manglarinos en Venezuela. Caso de Estudio: Refugio de Fauna y Reserva de Pesca Ciénaga Los Olivitos. Universidad Interamericana de Puerto Rico. Puerto Rico. April 1996**.**

Mantenimiento de la Diversidad de Especies por Perturbaciones. Zulia University. Maracaibo, Venezuela. July 1993.

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EDUCATION:

Ph.D. (Wildlife Ecology), Texas A&M University, College Station, spring 1996.

M.S. (Wildlife Ecology), Texas A&M University, College Station, spring 1992.

B.S. (Biology), Sul Ross State University, Alpine, Texas, fall 1988.

Forestry Technician, Escuela Tecnica Forestal No. 3 (Forestry Technical School), Saltillo, Coahuila, Mexico, summer 1984.

RESEARCH AND GEOGRAPHICAL INTERESTS:

Avian ecology; plant-animal interactions; Behavioral Ecology; Cranes; Wintering ecology; Threatened and endangered species; Ecosystem function; Arid and semiarid lands ecology; Coastal ecology; Conservation and management; Grasslands and grazing; Northern Mexico, Southwestern and central United States; Caribbean.

PROFESSIONAL EXPERIENCE:

Adjunct Professor. University of Houston-Clear Lake. January 2012-present.

Director, Conservation Programs. Gulf Coast Bird Observatory. January 2011-June 2016.

Executive Director. Platte River Whooping CraneTrust. October 2003-September 2010.

Adjunct Professor and Graduate Faculty, School of Natural Resources, University of Nebraska, Lincoln. February 2005-present.

Special Adjunct Professor of Biological Sciences, Department of Biological Sciences, Fort Hays State University, Hays, KS. September 2007-present.

Avian Ecologist. Platte River Whooping Crane Maintenance Trust. November 2001-December 2010.

Coordinator. Chihuahuan Desert Ecoregion Program, World Wildlife Fund. October 1998-March 2001.

Adjunct Professor in Avian Ecology. Caesar Kleberg Wildlife Research Institute and Department of Animal and Wildlife Science, Texas A&M University-Kingsville. Jan 1999-present.

Assistant Professor. Caesar Kleberg Wildlife Research Institute and Department of Animal and Wildlife Science, Texas A&M University-Kingsville. Jan 1996-October 1998.

Adjunct Member of Graduate Faculty. Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, TX. September 1996-present.

Lecturer. Department of Wildlife and Fisheries Sciences, Texas A&M University. August 1994 - December 1995.

Graduate Research Assistant., Department of Wildlife and Fisheries Sciences, Texas A&M University, 1989-1994.

Teaching Assistant. Department of Wildlife and Fisheries Sciences, Texas A&M University. Spring, fall 1991.

Teaching Assistant. Biology Department, Sul Ross State University. Spring 1988.

Research Associate. Chihuahuan Desert Research Institute. Biological control of saltcedar project, U.S. Department of Agriculture and Bureau of Reclamation. 1987-88.

Assistant Curator of birds and mammals. Vertebrate Collection, Sul Ross State University, 1985-1988.

Technical Assistant. Department of Resource Protection, Forest Service, Chihuahua, Chihuahua, Mexico, 1985.

Wildlife Inspector. Secretaria de Desarrollo Urbano y Ecologia (SEDUE), Chihuahua, Chihuahua, Mexico, 1984.

CLASSES TAUGHT:

BIOL. 485 (Ornithology), University of Nebraska, Kearney.
RWSC 4383 (Ecology of Arid and Semiarid Lands), Texas A&M-Kingsville.
WFSC 403 (Animal Ecology), Texas A&M University.
WFSC 408 (Techniques of Wildlife Management), Texas A&M University.
Laboratories taught:
RENR 215 (Fundamentals of Ecology), Texas A&M University.
BIOL 2403 (Comparative Vertebrate Anatomy), Sul Ross State University.
BIOL 5931 (Coastal Avian Ecology), University of Houston-Clear Lake
BIOL 585 (Ornithology), University of Nebraska, Kearney.

WSCI 6390 (Ecosystem Function and Management), Texas A&M-Kingsville.
Funcion y Manejo de Ecosistemas, Instituto Tecnologico de Monterrey, Monterrey, N.L.
WSCI 6387 (Wildlife Habitat Relationships),Texas A&M-Kingsville.
WSCI 6390 (Avian Community Ecology), Texas A&M-Kingsville.
RN-533 (Analisis de habitats de Fauna Silvestre) Universidad Autonoma Agraria Antonio Narro, Saltillo, Coahuila.

GRADUATE STUDENT ADVISING:

Committee Chair, PhD students
Luis Enrique Ramirez, Ingrid Barcelo Llanes, University of Nebraska; *Dan Kim, Dawn Sherry, Tsuyoshi Watanabe, and Christopher Appelt*, Texas A&M University.

Cochair, PhD Student, *Xiomara Galvez*, Departmento de Biologia, Universidad de La Habana, Cuba; *Yarelys Ferrer Sanchez, Romeo Tinajero, Edgar Lopez Saut*, Centro de Investigaciones Biologicas del Noroeste, La Paz, Baja California Sur.

Committee Chair, MS students
Todd Buckley, Karen Leavelle, University of Nebraska; *Mery Cassady*, University of Nebraska-Kearney, *Craig M. Westwood, Ken L. Jones, Glenn Proudfoot*, Texas A&M Univeristy-Kingsville; *Claudia Trevino, Amorita Salas*, Facultad de Biologia, Universidad Autonoma de Nuevo Leon, Monterrey, N.L.;*Alejandro Lozano* Dept. Recursos Naturales, Universidad Autonoma Agraria Antonio Narro, Saltillo, Coahuila.

Committee Member, MS students' graduate committees *Justin Anderson*, Fort Hays State University, (*Marie Fernandez, John Hitchcock, Charly Land, and Nathan Burkepile*) Texas A&M University-Kingsville.
Guillermo Romero, Universidad Autonoma de Nuevo Leon.

External Committee member, *Juan Jose Lopez*, PhD student, Departmento de Recursos Naturales, Universidad Autonoma Agraria Antonio Narro.
Guillermo Romero, PhD Student, Instituto de Investigaciones Biologicas del Noreste, La Paz, Baja California Sur.

PROFESSIONAL OFFICES AND COMMITTEES:

- <u>President</u>, North American Crane Working Group. 2014-2016.
- <u>Member</u>, Texas Academy of Sciences Board, 2015-2017
- <u>Member</u>, Waterbird Society Council. 2011-present
- <u>Member</u>, US-Canada Whooping Crane Recovery Team, 2005-present.

- <u>Member,</u> World Conservation Union, IUCN SSC/WI Crane Specialist Group, 2007-present.
- <u>Editor</u>, Proceedings of the 9th North American Crane Workshop
- <u>Vice-President</u> North American Crane Working Group, 2005-present.
- <u>Board Member</u>, North American Crane Working Group, 2003-present.
- <u>International Programs Coordinator</u>, Texas Academy of Sciences, 2003-2005
- <u>Member</u>, Stewardship Board, Ian Nicholson Audubon Center, 2002-present.
- <u>Member</u>, Steering Committee, Nebraska Partnership for All Bird Conservation, 2002-present.
- <u>Non-Academic Director and Board Member</u>, Texas Academy of Sciences, 2001-2004.
- <u>Chair</u>, Conservation and Management Section, Texas Academy of Sciences. 1998, 2001, 2004.
- <u>Vice-Chair</u>, Conservation and Management Section, Texas Academy of Sciences. 1997, 2000, 2003.
- <u>Vice-President</u>, Wildlife-Prickly Pear Cactus Relationship, The Professional Association for Cactus Development. 1997-present.

REFEREED PUBLICATIONS:

Chavez-Ramirez, F. 2016. The Cranes. In R. Valdez and J. A. Ortega, Wildlife Ecology and Management in Mexico. Texas A&M University Press.

Chavez-Ramirez, F. 2015. Las Grullas en Mexico. In R. Valdez and J. A. Ortega. Ecologia y manejo de fauna silvestre en Mexico. Universidad Autonoma de Chapingo Press. Pp. 147-158.

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Heredia, F. L. Scott-Morales, **F. Chavez-Ramirez**, M. Cotera Correa, M. Pando Moreno, E. Estrada Castillon. 2011. Aves en pastizales restaurados del valle del Rio Platte, centro-sur de Nebraska, USA. Ciencia UANL 14(3):264-272.

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PUBLICATIONS IN REVIEW OR IN PREPARATION:

Gil, K. and **F. Chavez-Ramirez.** In review. Temporal and Spatial distribution of roosting sandhill cranes in the Central Platte River Valley, Nebraska USA. Waterbirds.

Leavelle, K. M. and **F. Chavez-Ramirez**. (in review). Notes on nest characteristics, nestling cycle, and nest predation of the Blue-headed Quail-dove (*Starnoenas cyanocephala*) of

Cuba.

Leavelle, K. M., **F. Chavez-Ramirez,** and L. Powell. (in prep.) Occupancy and hábitat characteristics associated with the blue-headed quail dove (*Starnoenas cyanocephala)* of Cuba.

Jones, K.L, **F. Chavez-Ramirez**, X. Galvez-Aguilera, and J.V. Ashley. Population genetic structure in non-migratory sandhill cranes and the role of partial migration. Molecular Ecology.

Chavez-Ramirez, F. and R.D. Slack.). Spatial and interannual variation in time activity budgets of wintering whooping cranes.

Chavez-Ramirez, F., K. Gil de Weir, and W.B. Grant. (in prep) Foraging and energetics of wintering whooping cranes: a simulation of variable food availability and condition. Ecological Modelling.

Chavez-Ramirez, F. (In prep) Characteristics and correlates of Sandhill crane flocks in the Platte River Valley, Nebraska.

INVITED PRESENTATIONS:

Chavez-Ramirez, F. Ecology, conservation history and current issues of the endangered Whooping Crane in North America. Plenary presentation at Society of Wetland Scientist Annual Meeting, Corpus Christi, TX May 2016.

Chavez-Ramirez, F. Ecology and conservation history of the endangered Whooping Crane in North America. South China Institute of Endangered animals, Guangzhou, Guandong, China. February, 2013.

Chavez-Ramirez, F. Ecology and Conservation of Whooping Cranes. Texas Ornithological Society annual meeting. Lake Jackson, Texas, 2013.

Chavez-Ramirez, F. Wild Whooping Cranes: Current and emerging conservation issues. Plenary Presentation. 32nd Water Bird Society meeting, South Padre Island, Texas. Nov 5-8, 2008.

Chavez-Ramirez, F. Conservation of North American Cranes. University of Missouri, Columbia, Conservation Biology Seminar. 21 February, 2008.

Chavez-Ramirez, F. Research and Conservation Issues with North American Cranes. Rice University, Houston, Texas. 7 March, 2008.

Chavez-Ramirez, F. Cranes and Rivers: ecological connections and conservation issues. Water Resources Seminar, Water Resources Institute, University of Nebraska-Lincoln. 21 Feburary, 2007.

Chavez-Ramirez, F. Wildlife, water issues and conflicts. Colorado State University, Morgan Library Archives water tables. Fort Collins, 27 January, 2007.

Chavez-Ramirez, F. Status and Ecology of Sandhill Cranes in Cuba. Department of Biology, California State University, Northridge. Biology Colloquium. September 2003.

Chavez-Ramirez, F. Status and Ecology of Sandhill Cranes in Cuba. Wildlife and Fisheries Sciences Ecological Seminar Series. Texas A&M University, College Station, Texas. January 2002.

Chavez-Ramirez, F. Problems and solutions of implementing ecoregion-based conservation in the Chihuahuan Desert, Mexico. WWF-IUCN International workshop on Ecoregion Conservation. Lake Bogoria, Kenya, September 2000.

Chavez-Ramirez, F. Planning for biodiversity conservation in large scale initiatives. Smithsonian Institution-Mexico North Biocultural Conference and Workshop. Chihuahua, Chihuahua, Mexico, June 2000.

Chavez-Ramirez, F. History and current conservation efforts for the Whooping Crane in North America. 8th International Wildlife Conference Series, Universidad Autonoma de Tamaulipas, Cd. Victoria, Tamaulipas, Mexico. May, 2000.

Chavez-Ramirez, F. Raptors and Landscape use: habitat use by non-breeding raptor populations. Part of course "Animal ecology: new trends on ecological studies using raptor populations as models". Graduate Studies Program of Northwest Biological Research Center (CIBNOR), La Paz, Baja California Sur. November 1-13, 1999.

Chavez-Ramirez, F. Partnerships for Conservation in the Chihuahuan Desert. 5th Sympsosium on Resources of the Chihuahuan Desert Region: U.S. and Mexico. Alpine, Texas, October, 1999.

Chavez-Ramirez, F. Implementing Ecoregion Based Conservation in the Chihuahuan Desert. 14Th Global Biodiversity Forum, Montreal Quebec, Canada, June 18-20 1999.

Chavez-Ramirez, F. and K.L. Jones. Historia y conservacion de la Grulla Blanca en USA: Situacion genetica actual de la poblacion. Presentacion durante El Festival de las Grullas 1998, Sancti Espiritu, Cuba.

Chavez-Ramirez, F. Ecologia invernal y status actual de la Grulla Blanca en Norte America. Conferencia Especial, Departamento de Biologia, Universidad de la Habana, Cuba, Febrero, 1998.

Chavez-Ramirez, F. History and Conservation Status of the Whooping Crane. Conner Museum Seminar Series, TAMUK, Kingsville, Texas, January 1997.

Chavez-Ramirez, F. Food availability, foraging ecology, and energetics of Whooping Cranes

wintering in Texas. Canadian-U.S. Whooping Crane Recovery Team Meeting, Orlando Florida. February 12-13, 1997.

Cannon, J. and **F. Chavez-Ramirez**. Preliminary Evaluation of Potential Sites for reintroduction of a new flock of Whooping Cranes. Canadian-U.S. Whooping Crane Recovery Team Meeting, Orlando Florida. February 12-13, 1997.

Jones, K. and **F. Chavez-Ramirez**. Whooping Crane DNA Pedigree Analysis Proposal. Canadian-U.S. Whooping Cranes Recovery Team Meeting, Orlando Florida. February 12-13, 1997.

Chavez-Ramirez, F. Ecoturism Related to Birdwatching in South Texas. Luncheon Speaker, Agriculture and Human Sciences Education Workshop. TAMUK, Kingsville, Texas. May 8, 1997.

Chavez-Ramirez, F. El efecto de aves y mamiferos en la dispersion de semillas del Juniperus Ashei en Texas. Seminario Especial, Centro de Investigacion Biologicas del Noroeste, La Paz, Baja California Sur, Mexico. May, 1997.

Chavez-Ramirez, F. and M. Desmond. Proposal: Research on Wintering Ecology of Grassland birds in Northern Mexico. The National Park Service, Office of International Affairs, Las Cruces, NM. August 20, 1997.

Chavez-Ramirez, F. Conservation History and Current Status of Whooping Cranes. Keynote Speaker, Texas Ornithological Society Meeting. November 1996. Kingsville, Texas.

Chavez-Ramirez, F. Seed Dispersal System of Ashe Juniper in Texas. Special Seminar, Mitrani Center for Desert Ecology, Jacob Blaustein Institute for Desert Research, Ben-Gurion University of the Negev. November 1996. Midreshet, Sede Boker, Israel.

Chavez-Ramirez, F. Improving Roadside Management for Wildlife. Invited Speaker, Texas Vegetation Management Association Conference. October 1996. Corpus Christi, TX.

Chavez-Ramirez, F. Research and Conservation of Cuban Sandhill Cranes. International Crane Foundation Board of Directors Meeting. September 1996. Baraboo, Wisconsin.

Chavez-Ramirez, F. Relationship Between Foraging Ecology and Fitness in Whooping Cranes. Life Science Seminar Lecture Series, Biology Department. April 1996. Texas A&M Univ.-Kingsville.

NON-REFEREED PUBLICATIONS:

Chavez-Ramirez, F. 2004. Whooping Cranes in Nebraska: Historical and current trends. The Braided River, Newsletter of the Platte River Whooping Crane Trust. Issue 20.

Chavez-Ramirez, F. 2003. Whooping cranes, crabs, and freshwater inflows: a delicate chain.

The ICF Bugle, Quarterly Newsletter of the International Crane Foundation. Vol. 20 (4).

Chavez-Ramirez, F. 2003. Book Review: “ Cranes the noblest flyers: In natural history and cultural lore” by Alice Lindsey. Great Plains Research 13(1):161-162.

Chavez-Ramirez, F. 2002. The Cuban Sandhill Crane. The Braided River, Newsletter of Platte River Whooping Crane Trust, Wood River, NE. Issue 16.

Chavez-Ramirez, F. 2001. Preliminary results of banding and radiotelemetry of Cuban Sandhill Cranes. To International Crane Foundation and MacArthur Foundation.

Chavez-Ramirez, F. and K.L. Jones. 2000. Report on Advances of Cuban Sandhill Crane Conservation and Research activities. To International Crane Foundation, Baraboo, WI.

Wagner, Matt and **F. Chavez-Ramirez**. 1999. Conservation and management of nongame birds in the Tamaulipan Brush, Mexico. US-Mexico Conference on Wildlife Management and Conservation, Saltillo, Coahuila, Mexico.

Proudfoot, G.A., S.L.Beason and **F. Chavez-Ramirez**. 1999. Biology and Management of Ferruginous Pygmy-owl. Management Bull. #5. Ceasar Kleberg Wildlife Research Institute, Texas A&M University-Kingsville, Kingsville, TX.

Sherry, D. and **F. Chavez-Ramirez**. 1998. Evaluation of potential whooping crane wintering sites in Louisiana and Florida. Report to Whooping Crane Recovery Team, US – Canada

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Zink, R.M., G.A. Proudfoot, S. L. Beason and **F. Chavez-Ramirez**. 1996. Research report on genetic studies of the Ferruginous Pygmy-owl in southern Texas. Report submitted to the U.S. Fish and Wildlife Service, Corpus Christi, TX.

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Chavez-Ramirez, F., A. Tennant, and G.P. Vose. 1987. Fall migration of the peregrine falcon through Mexico. Chihuahuan Desert Discovery.

AWARDS AND RECOGNITIONS

Fellow, Texas Academy of Sciences (elected 1998).

Outstanding Doctoral Student, 1994-95, Department of Wildlife and Fisheries Sciences.

Phi Beta Delta, 1990; Gamma Sigma Delta, 1991.

Outstanding Undergraduate Biology Student, 1987-88.

Texas Good Neighbor Scholarship, 1986-1988.

Scarborough Foundation Scholarship, 1985-1992.

Dow-Roberta Puckett Scholarship, 1988.

Deans Honor List and National Deans List.

Scholastic All American.

Assistant to the Department of Military Discipline.

President, 1988, and Vice-President, 1987, Sul Ross Chapter of the Wildlife Society.

Vice-President, 1988, and Secretary-Treasurer, 1987, Sul Ross Biology Club.

APPENDIX B

DOCUMENTS CONSIDERED

DOCUMENTS CONSIDERED

Avian Power Line Interaction Committee (APLIC). 1994. Mitigating bird collisions with power lines: the state of the art in 1994. Edison Electric Institute, Washington, DC.

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